EXD.

FORTY-SEVENTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

IMP. BUR.
27 OCT. 1927
ENTOM.

CONDUCTED JOINTLY BY THE

NORTH CAROLINA DEPARTMENT OF AGRICULTURE

AND THE

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING

FOR THE

FISCAL YEAR ENDED JUNE 30, 1924

STATISTICAL REPORT YEAR ENDING DECEMBER 1, 1924

FORTY-SEVENTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

NORTH CAROLINA DEPARTMENT OF AGRICULTURE

AND THE

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING

FOR THE

FISCAL YEAR ENDED JUNE 30, 1924

STATISTICAL REPORT YEAR ENDING DECEMBER 1, 1924

Presses of
Edwards & Broughton Printing Company
State Printers

LETTER OF SUBMITTAL

RALEIGH, N. C., June 30, 1924.

To His Excellency, CAMERON MORRISON, *Governor of North Carolina.*

SIR: I have the honor to submit herewith report of the operations of the Agricultural Experiment Station, conducted jointly by the North Carolina Department of Agriculture and the North Carolina State College of Agriculture and Engineering, for the year ended June 30, 1924. The fiscal period for this report is from July 1, 1923, to June 30, 1924, but the statistical report is for the growing season ending December 1, 1924.

This report is made in accordance with requirements of the Act of Congress approved March 2, 1887, and known as the Hatch Act, and Chapter 68 of the Public Laws of 1913, and amended by Chapter 223 of the Public Laws of 1917.

Very respectfully,

B. W. KILGORE, *Director.*

CONTENTS

	PAGE
Letter of Submittal	3
Staff of Workers	5
Director's Summary	7
Financial Statement	27
Report of Field Crop Section, Division of Agronomy	29
Report of Soil Fertility Section, Division of Agronomy	40
Report of the Division of Animal Industry	46
Report of Poultry Investigations	63
Report of the Division of Entomology	67
Report of the Division of Plant Pathology	82
Report of the Division of Horticulture	86
Report on Drainage	94

BOARD OF AGRICULTURE

*W. A. Graham, *Chairman*

W. A. Brown	Rocky Point	*J. Vance McGougan	Fayetteville
*O. Max Gardner	Shelby	*Clarence Poe	Raleigh
J. J. Harris	Macon	R. W. Scott	Haw River
F. P. Latham	Belhaven	E. Grover Robertson	Leicester
W. B. McClelland	Stony Point	*T. J. Finch	Thomasville

BOARD OF TRUSTEES—NORTH CAROLINA STATE COLLEGE

Governor A. W. McLean, *Ex Officio Chairman*

Hon. A. T. Allen, *Member Ex Officio*, State Superintendent Public Instruction

*Dr. E. C. Brooks, President State College

Claude B. Williams	Elizabeth City	November 30, 1927
J. R. Turnage	Ayden	November 30, 1927
J. H. Saunders	Kinston	November 30, 1927
H. K. Burgwyn	Jackson	November 30, 1927
*T. T. Thorne	Rocky Mount	November 30, 1927
Charles U. Harris	Raleigh	November 30, 1927
*C. W. Gold	Greensboro	November 30, 1927
B. B. Gossett	Charlotte	November 30, 1927
*R. N. Page	Biscoe	November 30, 1927
P. S. Boyd	Mooresville	November 30, 1927
R. L. Bernhardt	Salisbury	November 30, 1927
J. E. Ramsey	Salisbury	November 30, 1927
J. M. Gamewell	Lexington	November 30, 1927
D. M. Buck	Bald Mountain	November 30, 1927
Maurice Hendrick	Cliffside	November 30, 1927
E. R. Johnson	Currituck	November 30, 1929
B. B. Everett	Palmyra	November 30, 1929
Charles W. Horne	Clayton	November 30, 1929
A. T. Bowler	Greensboro	November 30, 1929
R. T. Wilson	Yanceyville	November 30, 1929
T. L. Johnson	Lumberton	November 30, 1929
R. M. Cox	Winston-Salem	November 30, 1929
John W. Clark	Durham	November 30, 1929
E. F. McCullough	Elizabethtown	November 30, 1929
J. S. Watkins	Virgilina, Va.	November 30, 1929
*J. F. Diggs	Rockingham	November 30, 1929
R. L. Lambeth	Greensboro	November 30, 1929
G. L. Lyerly	Hickory	November 30, 1929
O. Max Gardner	Shelby	November 30, 1929
A. M. Dixon	Gastonia	November 30, 1929
L. H. Mann	Washington	November 30, 1931
Clayton Moore	Williamston	November 30, 1931
Raymond Maxwell	New Bern	November 30, 1931
R. H. Edwards	Goldsboro	November 30, 1931
John W. Carroll	Wallace	November 30, 1931
L. J. Poisson	Wilmington	November 30, 1931
J. L. Becton	Wilmington	November 30, 1931
I. B. Tucker	Whiteville	November 30, 1931
W. A. Bullock	Red Springs	November 30, 1931
R. W. Allen	Wadesboro	November 30, 1931
Mark Squires	Lenoir	November 30, 1931
Bishop J. M. Horner	Asheville	November 30, 1931
Harry L. Nettles	Biltmore, R. 1	November 30, 1931
W. D. Laroque	Kinston	November 30, 1931
S. F. Patterson	Roanoke Rapids	November 30, 1931
J. E. Porter	Aurora	November 30, 1933
B. F. Shelton	Speed	November 30, 1933
J. S. Hargett	Trenton	November 30, 1933
George L. Becton	Goldsboro	November 30, 1933
T. C. Whitaker	Trenton	November 30, 1933
R. H. Merritt	Raleigh	November 30, 1933
Clarence Poe	Raleigh	November 30, 1933
J. C. Gregson	Siler City	November 30, 1933
R. W. Christian	Manchester	November 30, 1933
H. P. Grier, Jr.	Statesville	November 30, 1933
F. H. Coffey	Lenoir	November 30, 1933
S. T. Henry	Spruce Pine	November 30, 1933
J. W. Haynes	Asheville	November 30, 1933
T. J. Harkins	Asheville	November 30, 1933
W. W. Neal	Marion	November 30, 1933

*Member of Joint Committee for Agricultural Work.

STAFF OF THE NORTH CAROLINA EXPERIMENT STATION

ADMINISTRATION

B. W. KILGORE.....Director, Experiment Station
C. B. WILLIAMS.....Vice-director, Experiment Station
F. E. MILLER.....Assistant Director, Branch Stations
F. H. JETER.....Agricultural Editor
A. F. BOWEN.....Bursar
MRS. C. G. HILL.....Bursar

AGRONOMY

R. Y. WINTERS
In Charge Plant Breeding Investigations
P. H. KIME....Assistant in Plant Breeding
G. M. GARREN...Assistant in Plant Breeding
W. F. PATE
In Charge Soil Fertility Investigations
S. K. JACKSON.....Assistant in Soils
H. B. MANN.....Assistant in Soils

L. G. WILLIS.....Soil Chemist
S. F. DAVIDSON.....Soil Survey
W. A. DAVIS.....Soil Survey
†R. C. JURNEY.....Soil Survey
†W. B. LEE.....Soil Survey

ENTOMOLOGY

FRANKLIN SHERMAN
Chief, Division of Entomology
Z. P. METCALF.....Entomologist
R. W. LEIBY
Assistant Entomologist Investigations
C. S. BRIMLEY.....Assistant Investigations

T. B. MITCHELL
Assistant Investigations and Field Work
J. C. CRAWFORD.....Assistant Investigations
J. A. HARRIS.....Assistant Investigations

HORTICULTURE

C. D. MATTHEWS
Chief, Division of Horticulture
ROBERT SCHMIDT.....Vegetable Culture
W. A. RADSPINNER
Asssitant Horticulturist, Pomology

C. F. WILLIAMS
Assistant Horticulturist, Research

ANIMAL INDUSTRY

R. S. CURTIS, Chief, Animal Industry Division
EARL H. HOSTETLER.....Swine Investigations
L. H. MCKAY Assistant Swine Investigations
VERNON WILLIAMS.....Dairy Investigations

J. O. HALVERSON
In Charge Feed and Nutrition
F. W. SHERWOOD.....Assistant in Nutrition
H. A. DICKERT.....Assistant in Nutrition

POULTRY

B. F. KAUPP.....Chairman, Poultry Group

R. S. DEARSTYNE
Associate in Poultry Diseases

PLANT PATHOLOGY

F. A. WOLF.....Plant Pathologist
S. J. LEHMAN.....Assistant Plant Pathologist

DRAINAGE

F. O. BARTEL, Drainage Engineer

BRANCH STATIONS

R. E. CURRIN, JR.....Assistant Director, Upper Coastal Plain Branch Station
L. O. PAGE.....Swine Herdsman
F. T. MEACHAM.....Assistant Director, Piedmont Branch Station
GRADY BERRY.....Herdsman
S. C. CLAPP.....Assistant Director, Mountain Branch Station
H. B. COULTER.....Dairy Herdsman
P. H. DUNCAN.....Poultryman
W. M. WHISENHUNT.....Foreman
CHARLES DEARING.....Assistant Director, Coastal Plain Branch Station
T. H. CAMERON.....Dairy Herdsman
C. D. BOLLINGER.....Poultryman
D. P. SOUTHERLAND.....Foreman
E. G. MOSS.....Assistant Director, Tobacco Branch Station
MORTON BURWELL.....Foreman
J. L. REA, JR.....Assistant Director, Blackland Branch Station
A. P. LEFEVERS.....Swine Herdsman

†In coöperation with United States Department of Agriculture.

FORTY-SEVENTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

B. W. Kilgore, *Director*
F. E. Miller, *Assistant Director Branch Stations*
F. H. Jeter, *Agricultural Editor*

One of the interesting developments relating to the work of the North Carolina Experiment Station during the past year has been the increased popularity of the branch station farms among the people of the section adjoining the farms. These farms are rapidly becoming community centers which people may visit to study the investigations being made and at which they may gather for picnics and field days. County agents, too, have brought small groups of interested farmers on visits of inspection to look into the results being secured with certain crops or with livestock. Approximately 15,000 people gathered at the six branch stations for annual meetings last year and this number does not include those who made visits alone or in small groups.

The stations have been improved in physical equipment so that they are now more nearly in a position to render the kind of service needed than ever before in their history. Some 176 definite projects are being studied, including those under way at the central plant and the branch farms. Progress is recorded in all of these problems; some have been reported upon and the salient facts have been given to extension workers that the farmers may realize upon the truths established.

Changes affecting the administration of the Station were these: The appointment of I. O. Schaub as Director of Extension, thus relieving Dean Kilgore of the details of administering this work. Prof. C. B. Williams, formerly chief of the Division of Agronomy, was placed in charge of the Station farm at the College, with a view to increasing the efficiency of the field work done at the Central Station. Agronomy research was divided with Dr. R. Y. Winters as head of the work with field crops and W. F. Pate in charge of soil fertility problems. Dr. B. F. Kaupp was made chairman of the poultry group in the College with all poultry research work of the station put under his direction.

There is a splendid spirit of coöperation between the research workers and the specialists of the extension division. The facts being determined by research soon find their way into the hands of the farmers through the various media used and the agricultural population of North Carolina is probably in closer touch with the scientific findings now than ever before.

Members of the Experiment Station staff are in demand as speakers before various public gathering and meetings of scientific bodies. They contribute also to the leading scientific journals, to the agricultural and trade magazines, and to the press of North Carolina. The articles are prepared with care, attention being devoted to a scholarly discussion of the subject as well as to the scientific facts under discussion.

CHANGES IN STAFF

Few changes in staff occurred among the experiment station workers last year. The changes made include the resignation of B. Naiman, as assistant in nutrition and the appointment of H. A. Dickert to the position; the appointment of C. D. Matthews as Professor of Horticulture in the School of Agriculture in addition to his duties with the Station; the appointment of L. H. McKay as assistant in swine investigation and teaching, and the taking over by the State Department of Agriculture of the Division of Markets under George R. Ross, recently appointed chief of the Division.

PUBLICATIONS

Due to lack of funds for printing, most publications giving the results of research work reported on last year by the Station were issued by the State Department of Agriculture. A credit line showing that the contribution was made by the Station appeared on each of these bulletins. The extension service also published some material prepared by the research staff. Quite a large number of articles appeared in the daily and weekly press and a special monthly service to at least two agricultural papers served to put these results before the reading public.

A total of six bulletins were issued by or for the Station last year. One thousand copies of the forty-sixth annual report were also printed and issued. These publications went to directors, libraries, to workers interested in a particular bulletin and to special subject matter mailing lists. Copies were also supplied to each home and farm agent in the State and to all newspapers, thus creating a constant demand for the information.

In addition to these requests from local sources, many requests are now being received each day from other states of the Union and from foreign countries. In all a total of 27,901 requests for experiment station publications were answered last year.

During the past year the State Department of Agriculture published the following bulletins for the Station:

March 1924. *Habits and Control of the Cotton Boll Weevil in North Carolina.* R. W. Leiby and J. A. Harris.

April 1924. *Cost of Clearing and Seeding Cut-over Land in Western North Carolina.* R. S. Curtis and F. T. Peden.

August 1924. *The Culling and Feeding of Poultry.* B. F. Kaupp.

September 1924. *Results of Fertilizer Experiments with Cotton and Irish Potatoes.* W. F. Pate and J. J. Skinner.

November 1924. *The Mexican Bean Beetle in North Carolina—Studies and Tests for Its Control.* J. C. Crawford.

The regular publications of the Station issued during the year are as follows:

Technical Bulletin No. 25. *Major Plant Communities in North Carolina.* B. W. Wells.

Annual Report. *Forty-sixth Annual Report of the North Carolina Experiment Station.* B. W. Kilgore, Director.

BRANCH EXPERIMENT STATIONS

The agricultural industry of North Carolina extends over a wide range of soil and climatic conditions. Such a situation clearly presents many farm problems peculiar to certain areas that cannot be dealt with at any one location. As a result, branch experiment stations have been established in the principal agricultural regions of the State, where problems having local application can be handled in a satisfactory manner. From the standpoint of service to all the farmers of the State at a minimum cost, this plan has given excellent results.

The experimental work is now conducted at eight permanent stations. The Central Station and Swine Research Station, both near Raleigh, deal largely with research projects and some of the more general farm problems, leaving those of local or regional importance to the six outlying stations.

At present 176 approved projects are being conducted on the experimental stations. These relate to practically every phase of the State's agriculture, and the solution of these problems will form the basis of the future agricultural development within the State.

In this summary special emphasis will be given to the kinds of work on the different stations due to their locations and to the improvements and notable results since the last report. A detailed report of projects will be covered in the reports of the subject matter divisions, which follow this general summary.

CENTRAL EXPERIMENT STATION

Soil type: Cecil Sandy Loam; Elevation above sea level, 390 feet; Mean annual temperature, 60.1; Average rainfall, 46.97 inches.

This station is located adjacent to the State College and serves as the home station where the investigators may conduct their research studies under personal observation. This location also gives the agricultural students the opportunity of studying the experimental and demonstration work of the station. The projects deal with dairy feeding experiments, plant disease investigations, horticulture and field crop studies.

The principal research problem of the Animal Industry Division is determining the effect of feeding cottonseed meal in different amounts and in combination with other feeds on the reproduction and lactation of the dairy cow. Similar tests are also conducted in determining the effect of feeding rations solely from the corn plant. The results of these investigations have contributed much information on fundamental problems in dairy and beef cattle feeding.

Cottonseed meal is a home product and is considered the cheapest, rich, protein dairy feed used generally over the country. The manufacturers of this meal and the men who feed it have been trying for some time to find a way to use it safely.

The poultry work deals with diseases of fowls, breeding studies and feeding tests, marketing experiments, problems in incubation and studies of the general pathology of the fowl. Valuable data has been secured from these tests. This information is used by the poultrymen of the State, and in the poultry class at State College.

The Agronomy work includes seed selection and improvement, variety tests and fertilizer studies. Considerable progress has been made in the seed-improvement projects, particularly with Mexican Big Boll Cotton, Leap's Prolific and Blue Stem Wheat, Abruzzi Rye, Lespedeza, vetch and soybeans. New strains have been developed and improved to meet conditions.

The work of the division of plant pathology has been very valuable and much definite information has been secured on the control of various plant diseases, which is being used generally over the State.

SWINE RESEARCH STATION

Soil type, Cecil Sandy Loam; Area, 72 acres; Elevation, 390 feet above sea level; Mean annual temperature, 60.1; Average rainfall, 46.97.

The station farm is located just south of Raleigh, and is given over entirely to investigational work with swine. The brick buildings are well arranged to meet the requirements of the swine work, including a nutrition barn, farrowing barn, feed barn and laboratory. This provides room for slaughtering, curing meat, mixing feed and for an office. The farm has been arranged into a system of pastures and feeding lots, which as a whole, is ideal for swine experimental work. The research work is under the direction of the departments of Swine Investigation and Animal Nutrition.

Nine definite projects deal with the problem of "soft pork" from various angles. This is a problem that confronts the swine industry of the entire south and the Station is endeavoring to determine the exact causes of soft pork and then the kinds of feed and amounts of each necessary to overcome this difficulty. The determination of these facts is of great economic importance since peanuts and soybeans, the real factors in causing soft pork, are grown extensively in the State, and are generally considered the cheapest feed for hogs.

The results of the "soft pork" investigations show that there is a varying degree of softness of the carcass depending upon the length of time the pigs are fed on a peanut ration. Corn, digester tankage and rice products will overcome in a measure at least the softening effect on the carcass caused by feeding peanuts and soybeans; pigs fed peanuts and rice products separately killed harder than those fed the two mixed together.

Four main projects are under way in determining the value of pasture crops for hops. The permanent pastures consist of orchard grass and clovers while the temporary pastures are of oats followed by soybeans.

One project in determining the cost of raising pigs to weaning time of eight weeks is under way and will be reported on later.

The Duroc Jersey breed of swine is used exclusively on the Station and sufficient number of brood sows are maintained to raise all pigs required for the different investigations.

MOUNTAIN EXPERIMENT STATION, SWANNANOA

Soil types, Congaree Sandy Loam and Ash Clay Loam; Area, 305 acres; Elevation, 2,600 feet above sea level; Mean annual temperature, 54.1; Annual rainfall, 41.06 inclusive.

This Station is to serve the agricultural interests of the mountain region of the State. The section has great agricultural possibilities principally with fruits, truck crops, dairying, poultry and pasture crops, and the work of the Station is planned with the view of developing these industries.

The station equipment has been greatly improved in the past three years, which has provided for additional experimental work on important problems for the region.

The poultry and dairy investigations which represent the two major projects recently added to the work, are now well established and giving good returns. The horticultural work has been enlarged to provide for additional work with fertilizers and methods of pruning.

Animal Industry. The dairy department is well equipped and the experimental work is progressing satisfactorily. The Jersey herd at present consists of two bulls, eleven heifers and eleven cows. These eleven cows produced during the year an average of 7,524.3 pounds of milk and 360.78 pounds of butter fat. The average for the State is about 3,000 pounds of milk and 135 pounds of butter fat. The dairy experimental work deals with feeding and pasture tests, herd development and management and marketing dairy projects.

Poultry Investigations. The poultry work is to deal with the problems peculiar to the mountain section. One of the most complete poultry plants in the State has been established on the Station, and the results so far secured show that the industry is well adapted to the region and is profitable if handled in an intelligent manner.

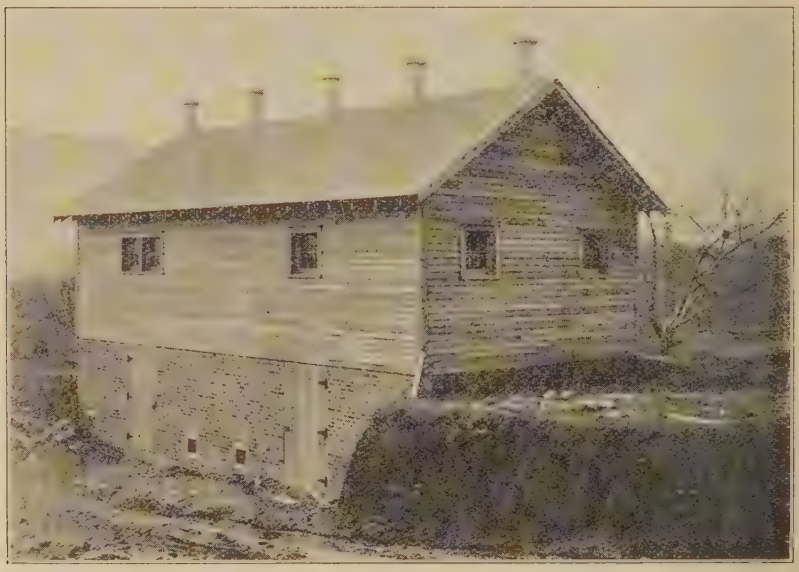
The experiments under way deal with studies in building up a farm flock, feeding tests, range experiments, commercial production, incubation, fattening experiments and marketing poultry products.

In the fattening work with 457 chickens for a period of fourteen days it required 4.2 pounds of mash and 8.4 pounds of milk to produce one pound gain. The cost per pound gain being 21½ cents, and the average price per pound received for the chickens was 33½ cents per pound, showing a profit of 12 cents per pound.

In the breeding experiments, the highest S. C. W. Leghorn laid 291 eggs and the highest S. C. R. I. Red laid 247 eggs in one year. The different units of the poultry plant are filled to the capacity and excellent progress is being made as a whole.

Horticulture. The mountain section offers great horticultural possibilities, and the work of this department on the station is to deal with the fundamental problems confronting the industry.

An apple-pruning experiment is one of the valuable projects on the Station and will furnish much needed information on the value of different systems and different amounts of pruning apple trees. The results so far secured indicate that growers have been pruning too severely, thereby causing a reduction in fruit production. Other tests with apples are to determine the value of thinning on the size of fruit and fruit bud formation; the value of different varieties, cultural methods and fertilizers.



The proper storage of apples, Irish potatoes and cabbage is a very important problem in the mountain section of the State. This storage house at the Mountain Experiment Station is used to conduct storage tests on the crops mentioned. The capacity is 5,000 bushels.

The work with peaches deals with varieties as to hardiness in Western North Carolina. Attention is also given to value of small fruit varieties and cultural methods.

The truck crop investigations include cabbage variety tests, Irish potato seed production, Irish potato hill and tuber unit seed selections and vegetable garden studies. The results of the Irish potato seed production indicate that Western North Carolina seed potatoes are superior to Northern grown seed for our spring crop in Eastern North Carolina.

Entomology. Aside from the general insect control measures for the section, the major project of the entomologists on the Station is the study

and control of the Mexican Bean Beetle. This insect is doing considerable damage in the western part of the State and is gradually moving eastward. The advance line of infestation is now entirely east of the mountains and extends in a fairly straight line approximately from the Catawba River at the South Carolina line to the Virginia line somewhat west of Mount Airy. Spraying or dusting with calcium arsenate so far has given best results in controlling the pest.

Agronomy. The agronomy work is made up of long time experiments, and the results become more valuable each year. The experiments have yielded a great deal of information on the fertilizer requirements of the different mountain crops which is being used generally over the region.

Field A. Soil fertility and rotation studies with corn, wheat and red clover. The results indicate that phosphoric acid, nitrogen and lime are needed to produce large yields and that phosphoric acid is the foremost plant food requirement.

Field of Virginia Soybeans grown for hay at the Mountain Experiment Station, Swannanoa.

Field B. Rotation and soil type tests showing the effect of continuous cropping in comparison with well-planned two and three year rotations where legumes are used.

Field D. Rock phosphate test in rotation of corn, wheat and red clover. The results so far secured show that acid phosphate is a more economical carrier of phosphoric acid than is rock phosphate on this soil.

Field F. Special potash test in rotation consisting of Irish potatoes, corn, wheat and red clover. The different sources of potash used have not materially affected the yield of potatoes and the normal fertilizer used of 800 pounds of an 8-4-6 seems to give best results.

Field G. To compare phosphoric materials with a complete fertilizer, with limestone and stable manure. The results indicate that limestone and manure with fertilizers give better results than where fertilizers are used alone.

The seed selection and improvement work has been mainly with soybeans, Haberlandt No. 38 and Biggs field corn, strain No. 17.

Tests are also conducted with wheat, oats and soybean varieties. The results have been very favorable, and the Station is now growing these improved seed for distribution to farmers of the section.

Improvements. During the year improvements have been made for an expansion of the work and facilitated the economic management of the station as a whole. The improvement items are as follows:

New five-room dwelling for the dairyman, new fruit and vegetable storage house (capacity 5,000 bushels), fencing additional pasture lands, clearing and preparing for planting five acres of the upland and a complete electric light system for all buildings on the Station.

The progress made at the Station has been very helpful to the farmers of the section. The Station is rapidly growing in popularity and is now considered the gathering place for those interested in agriculture. The third Thursday in August is set aside for the big annual field day and picnic, which has proved to be a very popular event, and has been helpful in getting the work before the farmers throughout the mountain section. An instructive program is prepared, which is followed by inspection trips to the fields where the results of the different experiments are explained by the specialists.

PIEDMONT EXPERIMENT STATION, STATESVILLE

Soil types, Cecil Sandy Loam and Cecil Clay Loam; Area, 208 acres; Elevation, 950 feet above sea level; Mean annual temperature, 58.6; Annual rainfall, 50.98 inches.

The station farm is located well to the center of the Piedmont region of the State. This area is suited to a wide range of agricultural pursuits and the program for work on the Station is to deal with important farm problems for the section. This is the second oldest station in the State, and much definite information has been secured which is being used generally over the region.

Horticulture. This work includes studies with small fruits, apples, peaches and pears in determining varieties, methods of cultivation, intercropping, pruning, spraying and marketing, and the results secured have been most instructive. A new four-acre experimental apple and peach orchard was planted in the spring of 1923, which includes some of the newer varieties for the Piedmont. Experiments are being conducted with this orchard from the standpoint of fertilization, pruning and intercropping.

Animal Industry. The work with livestock is confined mainly to hogs, sheep and feeding experiments with work stock. The main sheep project is to determine the kind of pasture suited to sheep under Piedmont conditions, and some interesting results have been obtained both with summer

and winter pastures. A flock of thirty ewes and one ram is maintained on the Station, and information is secured on the cost of maintaining breeding ewes and producing lambs. A series of pastures have been arranged which provides grazing practically the year round for the sheep and hog feeding tests.

The swine experiments show that it costs $3.97 to raise pigs to weaning age and that the number of pigs in the litter has little effect upon the size of each pig at weaning time. Complete information on the methods and cost of raising pigs to weaning age is given in a bulletin prepared by the Animal Industry Division. Further tests are under way to determine the value of different grazing crops for swine. Ten pure-bred Poland China brood sows and a boar were used in these experiments.

Feeding tests with farm work stock show that cottonseed meal is relished more by horses than by mules, and that one and one-half pounds can be fed daily to work stock. When cottonseed meal is fed, the grain ration is cheapened slightly.

Agronomy. The agronomy experiments are more extensive here than at any other station in the State. The tests include three series of soil fertility and rotation tests with cotton, corn, wheat, and red clover.

Field D. Brings out the value of well-planned rotations in comparison with continuous cropping.

Field E. Soil type studies.

Field F. Nitrogenous materials for corn and cotton.

Field G. Rock phosphate tests.

Field K. Tests with soft phosphates.

The November bulletin published on fertilizer experiments with wheat on Piedmont Red Clay Soils and wheat culture in North Carolina is a report on the results of the work with wheat on this Station, 1911 to 1921 inclusive, and the information contained therein is of value to the Piedmont farmers.

The seed selection and improvement work has been continued with the following crops: Appler oats, increased strain No. 11; Abruzzi rye, increased strain No. 7; Virginia soybeans, No. 11; Leap's Prolific wheat, increased strain No. 32; King Cotton strain No. 29; Mexican Big Boll Cotton; Weekley's Improved Corn, and variety studies with oats, rye and barley. The station is now growing these improved strains and distributing them to farmers over the Piedmont region at a reasonable cost.

The Mexican Big Boll Cotton, strain No. 4, developed on the Station, has been giving very good results and will be used in place of King 29 for the 1925 crop on the Station.

The tests with beardless barley show it to be a profitable crop for the section, from the standpoint of hardiness, yield and value as a feed.

General Crops. The present plan of the station farm gives seventy acres to experimental plats, forty acres to pasture, eighteen acres to orchard, twelve acres to grove, yards and garden, and approximately sixty-five acres to general crops. The general crop lands are handled in such a way as to demonstrate good farming methods for the section with the view of growing sufficient corn, oats and hay for the livestock, and to produce such money crops as may seem advisable.

This Station is a popular one with the general public and many visitors come to it seeking information on the various farm problems. The third Thursday in July is set aside for the big annual field day and picnic, and the attendance in 1924 was around six thousand people. Several smaller meetings were held during the year with good attendance for the purpose of recreation and studying the work of the Station.

The County Agents frequently bring groups of farmers from adjoining counties to study the results from the different experiments. These meetings are becoming more popular each year and are encouraged as they are one of the best means of bringing the farmers in touch with the Station and of getting results of our work put into practice.

Variety orchard with stock beets as an inter crop, Mountain Experiment Station, Swannanoa

TOBACCO EXPERIMENT STATION, OXFORD

Soil type, Granville Sandy Loam; Area, 250 acres; Elevation, 500 feet above sea level; Mean annual temperature, 58; Annual rainfall, 46.03 inches.

Work at this Station is confined largely to research with tobacco. Two temporary locations at Reidsville and Clarkton are also used. This arrangement permits the workers to carry on their investigations under conditions typical of the principal tobacco-growing areas within the State. The tobacco experimental work has been continued in coöperation with the Office of Tobacco Investigations, Washington, D. C.

On the Station at Oxford the investigational work with tobacco is divided into ten major projects.

(1) Fertilizer Tests in which the different sources of nitrogen, phosphorus and potash are tested alone and in combination with different amounts and ratios.

(2) Special Potash Tests in which sulphate and muriate of potash are compared in varying amounts running from twelve to eighty pounds per acre.

(3) Magnesium and Potash tests in which six sources of potash are tested out with magnesium limestone, calcite, and without any limestone.

(4) Special Fertilizer Tests in which C. P. chemicals are used to test out the effects of sulphur, chlorine, magnesia, sodium and calcium separately and collectively and to study the results of these various elements upon the structure of the leaf, its growth and burning quality.

(5) Variety Tests in which a number of varieties are tested, individual plant selections are made, hybrids are developed and records are kept on the yield, texture and growth.

(6) Rotation—three different crop rotations are tested, namely a two, three and four-year rotation using several of the principal crops grown in the flue-cured district.

(7) Tobacco after cowpeas or soybeans on which are used only phosphoric acid and potash in different amounts for the purpose of determining if it would be safe for the tobacco grower to use these legumes in this rotation immediately preceding tobacco.

(8) Quantitative Magnesium Tests. These tests are being made to determine the amount of magnesia necessary to control "sand drown" in tobacco.

(9) Nutrition Studies consisting of 216 plats, divided into two series. One series for the purpose of getting the effect of the different legumes on the three major crops, tobacco, corn and cotton; the other series to determine the effect of these three major crops on the small grain crops following, namely, wheat, oats and rye.

(10) The Use of Magnesium Limestone under Tobacco. This is for the purpose of determining the effects of magnesium limestone, which is a magnesium calcium carbonate, on the yield and quality of flue-cured tobacco. This test is made with different fertilizer treatments.

A total of 536 plats are required to carry on this work in the system of rotations.

Another project which has been given considerable attention during the past year relates to the burning quality of cured leaf of bright tobacco. A number of burning tests have been made in the laboratories at Washington by the Office of Tobacco Investigations. These tests were made with tobacco grown from the different sources and amounts of potash salts with quite interesting results. Also tobaccos have been sent to the different tobacco manufacturers so that they might make some of these tests in their laboratories, as the burning quality of tobacco is largely a manufacturer's problem. The tobacco companies with whom we have taken up this matter have gladly consented to coöperate along these particular lines. It has been impossible, however, to carry on this work and complete it because of the lack of help to follow it up.

In addition to the work done at Oxford at the Branch Experiment Station, quite a number of tests were made at Clarkton, N. C. The tests made at this point were practically the same as were conducted at Oxford, but in addition a larger number of ammoniates were tested, also the different ratios of complete fertilizers. The results secured here will furnish first hand information to the growers in the southeastern section.

There have also been a number of tests made at Reidsville in Rockingham County, N. C., for the purpose of serving the growers in this region.

The tobacco investigational work is being conducted on three separate soil types, and covering what is known by the tobacco trade as three distinct types of tobacco, namely, the South Carolina type, Central Old Belt type, and the West Old Belt type.

Special potash plots, Tobacco Experiment Station, Oxford.

In addition to these experiments the Station has coöperated with the tobacco specialists of the Extension Service in conducting a large number of demonstrations in a number of different counties of the State. The results of these demonstration plats have conformed remarkably well to the average results obtained at the Tobacco Experiment Station, and have been helpful in getting the results from research put into practice.

The outstanding results obtained this year have been the effects of magnesium limestone on control of "sand drown" and in increasing the yield and quality of tobacco. The average increased yield and increased value of the lime plats over the unlimed plats covering a period of four years with

144 plats has been 174½ pounds and $55.82 per acre. It is possible that 50 per cent of the tobacco soils of North Carolina need magnesium limestone, and if half of the 600,000 acres planted to tobacco can be made to make an increase of $25.00 per acre, the value of the tobacco crop would be materially increased.

The Tobacco Experiment Station is rapidly becoming more popular with the growers in the State as is indicated by the increased number of visitors each year. Several meetings have been held at the Station this year at which experimental work has been studied and results observed in the field with discussions of various phases.

Superintendent's dwelling and the office building at the Tobacco Experiment Station, Oxford

On August 14th around 1,500 farmers and business men attended the annual field day at this Station. Several members of the Board of Agriculture and officials of the Department of Agriculture attended this meeting and discussed the object of Experiment Station work and the results obtained. This was followed by inspection trips to experimental plats. During the season representatives of the fertilizer manufacturers and fertilizer dealers visited the Station to discuss fertilizer problems for tobacco. Several County Agents brought farmers to the Station to study tobacco problems. In all there have been a larger number of farmers both locally and from other counties to visit the Station this year than heretofore. The local High School has also taken more interest in the work this year than previously.

Improvements. The major improvements during the year have been along the lines of drainage and clearing land. The drainage project will be completed by the close of the year. This will add to the value of the farm and greatly improve the general appearance. The survey which was prepared by the Drainage Division required 2,800 feet of tile ranging from 8 to 18 inches; 2,000 feet of 6 inch and 3,000 feet of 4 inch tile. This will make fifty acres of land available for cultivation heretofore idle for lack of proper drainage and will also benefit the adjoining lands. The new lands will be used for enlarging the general crop work on the Station during the coming year and later given over to experimental work as needed.

The crops as a whole were not as good as last season on account of the unusual seasonal conditions; however the experimental results compared favorably with any year since the Station has been established. Plenty of feed stuff has been produced to take care of the work stock, and the general condition of the Station is better than it has ever been. All of the buildings are in good shape. Some changes are to be made on the grounds as soon as finances will permit.

UPPER COASTAL PLAIN EXPERIMENT STATION, ROCKY MOUNT

Soil types, Norfolk Sandy Loam and Norfolk Fine Sandy Loam; Area, 202 acres; Elevation, 105 feet above sea level; Mean annual temperature, 60.8; Annual rainfall, 49.15 inches.

The purpose of this Station is to serve the farmers of the upper coastal plain region of the State. The program of work is planned with the view of giving first consideration to the most urgent farm problems of the section. At present boll weevil control, soil fertility, seed improvement, swine feeding tests, cropping systems and horticultural investigations have been deemed most important, and the experiments now under way are carefully planned to furnish new information on these subjects.

Swine Investigations. The primary object of this work is to determine the cost of carrying a pure-bred herd of Hampshire hogs under average farm conditions. This is to include the value of different feeds, pasture crops and utilizing all the so-called waste from the farm. Twelve pure-bred Hampshire sows and a boar are kept at the station and the experimental work is carried on with the offspring from these animals. Under the present plan two car-loads of hogs are shipped from the Station each year.

Agronomy. The extensive field crop rotation experiment started last spring made a very creditable showing for the first year, and will become more valuable each year in determining the better rotations for the section.

The series of fertilizer experiments to determine the effect of different formula and applications on maturity and yield of cotton under boll weevil conditions, show considerable difference in the first picking of cotton in favor of high or reasonably high percentages of acid phosphate, and that a heavier application of fertilizer than generally used is profitable.

The cotton-breeding work is confined to the Mexican Big Boll variety. The strain developed here is meeting with much favor over the cotton growing area of the State due to its uniformity, yield and length of staple. The Station planted thirty-five acres this year using the selected seed from last

year's crop and will make close to thirty bales in spite of the unfavorable weather conditions. The seed from the 1924 crop have been engaged in advance for planting purposes. Breeding work has also been started with Latham's Double corn and Fulghum oats.

The work of producing important strains of seed of the better varieties for the section and distributing them at a fair price to the farmers in the section is proving a great factor in agricultural uplift.

From the agronomic side of the boll weevil control studies, experiments were conducted along the lines of cotton spacing tests, date of seeding, preparations of ground for planting and cottonseed treatments. Since the boll weevil did very little if any damage to the cotton crop on the station this year, the information secured from these tests would not apply to boll weevil conditions, although the results were very interesting. In the seed treatment tests the nitrate of soda treatment delayed germination and reduced the number of plants per plat. The plats planted to graded seed gave an increase of 195.5 pounds of seed per acre more than those planted to ungraded seed.

Horticulture. A year-round farm garden is demonstrated on the station showing the possibilities of having fresh vegetables for the table at all seasons.

The variety pecan orchard yielded a medium crop this year, and the results were favorable in further proving the better varieties for the upper coastal plain region, namely, Schley, Stuart, Alley and Success.

The sweet potato seed selection and improvement work showed good results, and one hundred bushels of improved Porto Rico and Nancy Hall seed potatoes were distributed to growers in Eastern North Carolina last season. With the new modern sweet potato storage house completed in 1922, storage tests were conducted to determine best methods of storing sweet potatoes, also the storage qualities of different commercial varieties.

Improvements. During the year completed improvements have greatly added to the general appearance of the Station, and have allowed for an expansion of the experimental work. This includes the new office building and equipment, repairing and enlarging main dwelling, repairing all tenant houses, fencing additional hog lots and pastures, new insectary, improving drainage system, and landscape plantings.

The general farm work is planned to serve as a demonstration of good farm practices for the upper coastal plain region. The main field crops grown on the Station are corn, cotton, sweet potatoes, oats and soybeans.

The Station is having more calls than ever before for information on various farm problems, and many visitors have studied the work of the Station during the past crop season.

The second annual field day was held last August with very gratifying results. About 2,000 people attended the meeting and all seemed very much interested in the Station work. The morning program was given over to addresses by the leading Station workers, which was followed in the afternoon with inspection trips to the experimental fields.

BLACKLAND EXPERIMENT STATION, WENONA

Soil Types, Peat and Muck; Area, 200 acres; Elevation, 16 feet above sea level; Mean annual temperature, 59.5; Annual rainfall, 55.05 inches.

The Station was established for the purpose of serving the farming interests of the large black land area of the Eastern part of the State. One of the largest agricultural developments in recent years has been on these lands. The question of drainage has been provided, and large areas have been cleared and brought into cultivation. The soil has an excess of fertility, but much definite information is needed on the methods of handling these soils for the best crop results. The work on the Station is planned with the view of determining a safe agricultural program for the black land farmers.

Showing group of buildings on Blackland Experiment Station near Wenona.

Agronomy. Corn has been the only money crop so far tried that succeeds well the first year after clearing, but the practice of continuous cropping with corn even though lime has been applied tends to decrease the original yield. More information is needed on the value of fertilizers and crops that can be grown in rotation with corn. With this in view a three-year fertilizer rotation test was started on the Station three years ago; the first year corn, the second year spring oats followed by soybeans for seed or hay, third year Irish potatoes followed by soybeans for seed or hay. Considerable information has been obtained from this test; the oats, soybeans and corn making a very favorable showing. The Irish potato yield in the rotation was very low each year.

The lime test conducted, further proved that lime is essential to the production of corn and soybeans, and that finally ground limestone gives better results than marl or hydrated lime.

The fertilizer experiments indicate that stable manure, nitrate of soda and kainit applied separately or in combination will increase the yield of corn. Acid phosphate seems to have very little, if any, value when used alone or in combination with other materials.

The experiments with rye, hay crops, cultural practices, pasture mixtures and seed improvement have been continued and additional information has been secured.

Swine Investigation. The work with swine started three years ago has probably attracted more attention than any other phase of the experimental work. At the time the experiment was started, corn being the principal money crop of the section, was selling at 60 cents per bushel which was below the cost of production, and a different method of marketing the corn was desired very much. The feeding tests the first year showed that the farmer could get $1.10 per bushel for his 60 cent corn by feeding it to hogs. The results also showed that fish meal and shelled corn were better than tankage and shelled corn from the standpoint of gain and cost. The feeding experiments have been continued, with very satisfactory results. Two carloads of hogs are raised on the Station each year for the feeding experiments. The lot of sixty-six pigs marketed in August 1924 brought 10¾ cents per pound in the Richmond market, which netted the Station $1,316.50.

Drainage. The early drainage investigations have proven the value of tile drainage for muck soils. This was doubtful at the beginning of the test owing to the extremely flat grade required in laying the tile and to the character of the soil. However 3.6 miles of tile are now in use on the Station farm, and it works perfectly. Some of the lines have been in use for nine years. The size of the tile ranges from four to fifteen inches and is laid at a minimum depth of four feet. The grade used varies from one-half to one inch per hundred feet. The lines are spaced 330 feet apart; this being the standard spacing for all open ditches in this section.

Horticulture. Some tests have been made with vegetable crops, and the results secured have been quite encouraging. It is planned to enlarge this work during the coming year as the soil and climate seem well suited to the industry.

General Crops. Approximately ninety acres of the station are devoted to general crops. This area is planted to hay, oats and corn with the view of producing sufficient feed for the work stock, and supplying corn for the extensive hog-feeding experiments.

Improvements. The remaining seventy-five acres of uncleared land on the Station is being cleared and fenced, and when completed will be given over to beef-cattle investigations.

A modern implement shed, 34x60 feet, with loft above for storage has been completed.

Scales especially equipped for weighing experimental hogs have been purchased and set up under a shelter convenient to the hog lots.

The central hog-feeding house and the new farrowing houses were painted during the summer. Considerable progress has been made in carrying out the landscape plans as furnished by the U. S. Department of Agriculture, which, when completed, will greatly add to the general appearance of the Station.

COASTAL PLAIN EXPERIMENT STATION, WILLARD

Soil type, Norfolk Sandy Loam; Area, 250 acres; Elevation, 51 feet above sea level; mean annual temperature, 62.1; Annual rainfall, 50.86 inches.

The experimental work at this Station deals with the kind of farming for the lower coastal plain region of the State, and much valuable information has been secured from the many lines of investigational work which is being used generally by the farmers of the section. The long time experiments have been carried forward with good results. Several new projects have been added to the program of work, and important improvements have been made during the past year, which will add to the efficiency of the Station as a whole.

Harvesting Iceberg lettuce near the Lower Coastal Plain Station. The Iceberg is fast supplanting the Big Boston type.

Animal Industry. The Jersey dairy herd at this station now consists of two herd bulls, eight bull calves, sixteen heifers, and twenty-two cows in milk. Of these twenty-two, five are heifers which freshened during the year. The other seventeen that were in the milking herd produced an average of 7,025.6 pounds of milk and 365.05 pounds of butterfat.

Three daughters of Eminent 19th completed Register of Merit records during the year producing 612.21, 551.85, and 534.82 pounds of butterfat respectively.

Lass G's Ola, No. 491463, daughter of Rumina's King, senior herd bull, and granddaughter of Eminent 19th, completed a very good record of 565.87 pounds of butterfat, starting at two years and ten months, which wins the American Jersey Cattle Club Silver Medal for her and makes her State Class Champion over all breeds.

The records made at the Station clearly show the extent to which a herd can be developed in a few years by the use of bulls whose ancestry is well filled with high production records.

Horticulture. Several new varieties of Muscadine grapes have been developed in the grape breeding experiments which are very promising. Additional information has been secured on the best methods of pruning and training from the standpoint of increased production. The grape utilization work has been continued, and a portion of the 1923 crop will be marketed in the form of grape juice and jelly.

The three acres of strawberries interplanted with the muscadine utilization vineyard made good returns this year, indicating the value of this "two-story horticulture" for the section.

One acre of dewberries has been planted, which includes the imported varieties and will serve as a valuable demonstration.

The first year's results from the project of growing narcissus bulbs on the Station shows that the location is well adapted to bulb culture, and that the sale of cut flowers will carry the cost of maintenance. The first crop of bulbs will be marketed in 1925.

The pecan orchard yielded a medium crop of pecans and further proves the value of the Schley, Stuart and Alley varieties for the section.

In the sweet potato variety tests, the Nancy Hall and Porto Rico have proved their desirability from the standpoint of yield and storage qualities.

Poultry Investigations. The poultry work has been very helpful to the poultrymen of the section in supplying breeding stock and furnishing information on improved methods.

The poultry marketing and feeding experiments prove that simple rations as equal parts corn meal and ground oats with milk give as good results as the more complex and expensive mixtures.

Agronomy. The fertilizer and rotation experiments have been carried forward and additional information has been secured on the proper application of fertilizers, and the value of lime in a three-year rotation of cotton, corn, and soybeans.

A pasture experiment consisting of ten different experimental plantings has been made in an effort to determine the kinds of pasture grasses best suited to the section.

The seed production and improvement work with Cocke's Prolific corn and Norfolk Early Market corn has been continued with good results.

Improvements. The "Scott Field" has been tile drained and the area brought under cultivation. This adds thirty-five acres of new good land to the farming area of the station.

The poultry work has been enlarged by fencing three acres additional in poultry runs and providing two new modern range houses. The experimental work made possible by this expansion will deal chiefly with feeding tests in comparing the value of meat meal and milk in poultry rations.

All buildings on the Station have been repaired and painted which greatly adds to the general appearance of the station as a whole.

The station is now furnished with electric lights, having connected with the electric plant at Wallace.

The annual farmers field day and picnic held on the second Thursday of September has proved to be a great event and as a means of getting the Station and farmers together. Approximately 5,000 people attended the meeting this year. A program of appropriate instructions was prepared which was followed by inspection trips over the work of the Station.

INSECT AND PLANT DISEASE CONTROL

The insect and plant disease control measures on all stations are under the direction of the Divisions of Entomology and Botany. The spray calendar for each Station is prepared by these divisions and the actual spraying or dusting operations are under close supervision.

DIVISION REPORTS

Complete information as to the work of the various divisions of the Experiment Station are contained in the report by divisions which follow the financial statement.

FINANCIAL REPORT

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,
In Account With the UNITED STATES APPROPRIATION, 1923-1924.

Dr.

	Hatch Fund	*Adams Fund*
To receipts from the Treasurer of the United States, as per appropriation for the fiscal year ended June 30, 1923, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams Fund)	$15,000.00	$15,000.00

Cr.

Salaries	$12,415.59	$13,415.00
Labor	1,882.00	924.05
Stationery and office supplies	152.39	.....
Scientific supplies, consumable	124.60	344.52
Sundry supplies	.....	.....
Communication service	51.25	.....
Traveling expenses	.....	76.66
Transportation of things	26.31	63.85
Heat, light and water	347.86	.....
Scientific equipment	.....	110.43
	$15,000.00	$15,000.00

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,
In Account With FARM AND MISCELLANEOUS RECEIPTS.

Dr.

Receipts from other sources than the United States for the year ending June 30, 1924	$9,396.85

Cr.

Salaries	$ 33.34
Labor	1,809.69
Stationery and office supplies	12.25
Feeding stuffs	10.93
Sundry supplies	815.24
Fertilizers	1,117.73
Communication service	38.00
Travel expenses	140.57
Publications	114.53

Heat, light, water and power	$ 31.30
Furniture, furnishings and fixtures	199.35
Library	81.51
Scientific supplies	666.17
Livestock	300.00
Tools, machinery and appliances	1,374.98
Buildings and land	6.40
Contingent expenses	500.00
Unexpended balance	2,144.86
Total	$9,396.85

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the North Carolina Agricultural Experiment Station for the fiscal year ended June 30, 1924; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was nothing on the Hatch Fund and nothing on the Adams Fund; that the receipts for the year from the Treasurer of the United States were $15,000 under the act of Congress of March 2, 1887, and $15,000 under the act of Congress of March 16, 1906, and the corresponding disbursements $15,000 and $15,000; for all of which proper vouchers are on file and have been by us examined and found correct, leaving balances of nothing.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, and March 16, 1906, and in accordance with the terms of said acts, respectively.

Signed:

R. C. BIRMINGHAM & CO.,
By R. C. BIRMINGHAM, C. P. A.,
Auditors.

(SEAL)

Attest:
A. F. BOWEN, *Custodian of the Seal.*

REPORT OF FIELD CROP SECTION

OF THE

DIVISION OF AGRONOMY

To the Director: The field crop work of the past year has consisted of seed-improvement investigations, crop-culture experiments, and seed-treatment tests. This work has been conducted on the Central and Branch Experiment Station Farms. The following is a brief account of the work done during the past year along with some of the important results secured.

RESULTS ON THE MOUNTAIN STATION FARM

Six field crop projects are in progress at the Mountain Station. These include variety tests of spring oats, soybeans and stock beets, and seed selection work with corn and soybeans. The severe winter in the mountain section limits the production of oats to spring plantings. Former tests with winter oats planted in the fall proved that this practice was unsafe on account of winter killings. The recent work has had for its purpose the testing of local and improved strains of winter and spring oats. Seed of improved strains were secured from northern experiment stations. In these tests the Fulghum oat, an early southern winter strain, has yielded best. The soybean variety tests at this station have included eleven of the earlier varieties of this crop. This year, as in former years, the soybeans have attracted a large number of visitors and have had considerable influence in the introduction of the crop into the mountain section. The pedigreed strain of Haberlandt No. 38, continues to lead in yield of seed at this Station and is gradually being distributed to farmers of the mountain section. In order to better fit the Haberlandt to mountain conditions plant-to-row selection work has been conducted during the past two years. The selections have shown considerable variation in earliness and ability to stand upright at the time of maturity. The selections from Haberlandt No. 38 soybeans at this Station will furnish the mountain section with a productive soybean which fits the short season there.

The testing of stock beet varieties was started by Mr. S. C. Clapp, superintendent of the Station. Although this was started primarily to determine the best source of vegetable winter food for poultry, the results will also be valuable for the small dairymen of the mountains who do not have sufficient cows to warrant the construction of a silo.

The selection work with seed corn has been continued, a special effort being made to save as much good seed corn this season as possible on account of the damage by early frost to the seed corn of portions of the mountain section.

RESULTS ON THE PIEDMONT BRANCH STATION FARM

The field crop work at the Piedmont Branch Station has consisted of small grain culture tests, small grain variety tests, cotton culture tests, cotton improvement and corn improvement. The small grain culture tests which have been in progress five years include comparison of different dates and rates of seeding wheat and oats. The following table contains the average results for wheat. The results indicate that the period between October 15 and November 1 is the best time and 90 pounds per acre the best rate for seeding wheat in the section of the State represented by this Station.

Table No. II contains similar results for seed oats, showing that the best results are secured from seedings made between October 15 and November 1, with a seeding of three bushels per acre. The field work on this project has been discontinued and the results are being prepared for publication.

TABLE I—WHEAT CULTURE STUDIES

AVERAGE YIELDS FROM DIFFERENT DATES AND RATES OF SEEDING ON PIEDMONT BRANCH STATION, STATESVILLE, NORTH CAROLINA

Dates of Seedings	Rates of Seeding, Pounds Per Acre				Average For Dates
	Thirty	Sixty	Ninety	One Hundred twenty	
October 1	9.0	11.8	12.7	11.6	11.2
October 15	11.6	13.8	15.2	15.4	15.0
November 1	13.1	15.8	15.2	16.1	15.0
November 15	10.7	12.6	14.4	14.9	13.1
December 1	6.4	9.3	7.5	8.5	7.9
Average for rates	10.1	12.6	13.0	13.3	

TABLE II—OAT CULTURE STUDIES

AVERAGE YIELDS FROM DIFFERENT DATES AND RATES OF SEEDING, PIEDMONT BRANCH STATION, STATESVILLE, N. C.

Dates of Seedings	Rates of Seeding, Pounds Per Acre				Average For Dates
	Thirty	Sixty	Ninety	One Hundred twenty	
September 1	18.7	20.9	21.6	20.4	20.4
September 15	16.1	22.5	25.2	25.3	22 2
October 1	29.2	31.4	31.8	32.9	31.3
October 15	30.9	5.8	42.0	41.0	37.6
November 1	32.1	37.6	42.4	38.3	37.6
November 15	19.2	26.8	32.0	35.3	28.3
Average for rates	24.3	29.1	32.5	32.2	

The work with small grain varieties has consisted of field tests with standard varieties of wheat, oats, barley and rye. In the wheat work Leap's Prolific and Fulcaster continue to lead though Alabama Blue Stem and Gleason are very promising varieties. The Alabama Blue Stem is particularly well adapted to the light soils of the Piedmont section and Gleason has been remarkable for its resistance to rust. The Fulghum oat has been the highest yielding oat, with Appler a close second. The oat variety tests have given splendid information in regard to the relative yields or ordinary commercial seed oats and oats of the same variety selected for high yield and properly handled. The pedigreed Fulghum oats have averaged seventeen bushels per acre more than the ordinary commercial seed bought of seedsmen. The pedigreed Abruzzi rye improved at this Station has continued to hold the lead in the rye variety test. This strain of Abruzzi rye has furnished a good source of seed during the past five years.

During the past two years this Station has conducted work with barley varieties to determine their relative yield when compared with oats and to determine the best strain for the Piedmont section. In these tests the oats have produced the heavier yield during mild seasons, but are not as winter hardy as barley. On account of the custom of seeding all small grain rather late barley will succeed better on lands subject to winter killing. In the barley tests the pedigreed strain of hooded barley No. 6 from the Tennessee Experiment Station has yielded best.

The cotton culture tests include studies of early bedding as compared with fresh bedding and close spacing of plants in the row compared with broad spacing. This project was started the past season and the complete results have not been secured.

In the corn improvement project the modified ear-to-row method of selection has been practiced. This work has established a source of good seed for the Piedmont section. The field meetings of farmers and county agents held at these plats have stimulated interest in the field selection of corn in this section.

CENTRAL STATION

The field crop work at the Central Station has included two research or Adam's projects with cotton, seven research projects in coöperation with graduate students of the College and eleven Hatch projects. The following is a list of these projects with a summary of the results.

COTTON RESEARCH (ADAMS PROJECT NO. 14)

This study of the inheritance and association of economic characters in the cotton plant was started in 1913. The work has consisted of isolating from one variety of cotton several strains varying in earliness, habit of branching, amount of vegetative growth, size of boll, amount of fuzz, covering on the seed, length of staple and yield. Careful data has also been taken on the temperature and rainfall during the growing season and particularly the reaction of the different types to seasonal conditions. The main portion of the field results was completed in 1921 but certain strains have been continued to check results that are at variance with other authors.

Two papers have been prepared from the above material, one concerning the relation of rainfall at the time of blooming to the balance between fruiting and vegetative growth, and the other deals with the inheritance of fuzz on the seed coat of cotton and its probable economic value.

Place Effect Studies With Cotton

In this work a study has been made of cotton plants produced from seed of the same pure line, part of which were grown in Mississippi and part in North Carolina. Certain growers of Mississippi were of the opinion that North Carolina grown cotton seed gave an earlier crop than their home-grown seed. Although the plantings were made for five years, only during three years was the stand sufficient to obtain reliable results. During two of three years the seed grown in Mississippi produced plants that were slightly taller at blooming time and at maturity. The Mississippi grown seed also produced slightly earlier maturity when measured by the percentage of crop opened at a given date. The data on rainfall and temperature taken at the two points showed practically no difference. Differences were found in the size and weight of seed produced in the two localities, the Mississippi seed being larger. A third comparison in which large seed were supplied from North Carolina gave slightly earlier plants in the North Carolina plantings. This work has been discontinued on account of the difficulty of securing uniform stands at the two points the same year.

Cotton Research Projects Conducted in Coöperation with Graduate Students

From time to time the cotton investigations have suggested problems of interest and economic value which could not be handled by the regular workers in this field. Seven such problems have been studied in coöperation with graduate students who have chosen them as major problems. In each case the students have had a problem outlined and supervised wit hthe understanding that the data thus secured could be used by the Experiment Station. The following is a list of the projects that have been treated in this way, along with a brief summary of the results.

1. A study of the diameter and tensile strength of cotton fibers from five varieties of cotton which were grown under the same conditions. This work was through the coöperation of R. Y. Winters, Plant Breeding Agronomist and J. B. Cotner, graduate student.

Results. In the examination of fibers from five varieties of cotton, Cleveland Big Boll, Mexican Big Boll, King, Cook and Rowden, considerable differences were found in the average diameters and tensile strength. There was a direct relation between diameter and tensile strength, the varieties with the broader fibers having the greater breaking strength. Among the varieties studied, Mexican Big Boll gave the greatest diameter, 22.576 microns and the greatest strength 54.54 decigrams, while Cleveland Big Boll furnished fibers of the smallest diameter 18.836 microns and a breaking strength of 31.43 decigrams. The correlation tables for each variety show a direct relation between diameter of fiber and tensile strength, the broader fiber being stronger. The correlation between diameter of fiber and tensile strength for all varieties was .623 + — .013 showing a positive relation.

2. A study of the density of cotton fibers on the seed coat and its relation to other physical qualities of the fiber. This work was conducted in cooperation between R. Y. Winters, Plant Breeding Agronomist, and L. I. Henning, a graduate student.

Results. In this work a new method of determining the density of cotton fiber population on the seed coat has been suggested. It consists of the use of a sharpened leather punch which cuts out a section of the seed coat of known area. By counting the fibers attached it is possible to determine the relative number of fibers on different portions of the seed and on seeds of different plants. In the material studies the following relations were found: As the fiber population increased, the diameter of fiber, the lint index and percentage of lint increased and the length of fiber and weight of seed decreased. Decrease in length was associated with increased diameter.

3. A study of the relation between length and diameter of cotton fibers. Conducted in coöperation between R. Y. Winters, Plant Breeding Agronomist, and P. J. Naude, a graduate student.

Results. The results from the material used show that as the length of fibers increase the per cent of lint and diameter of fibers decrease. The correlation between length and diameter of fibers is $0.02929 + — 0.03560$. The correlation between length of fibers and per cent of lint is $0.2650 + — .03621$. Increase in size of seed was found to be slightly associated with longer fibers. The correlation between these two characters is $+ 0.11303 + — 0.03845$.

4. A study of the density of fiber population on the cotton seed coat and its relation to the twist in fiber. Conducted in coöperation between R. Y. Winters, Plant Breeding Agronomist, and T. C. Chang, graduate student.

Results. Increased density of fiber population is definitely associated with increased number of twists per inch. Increased length was found to be associated with decrease in number of twists per inch. When the fibers were divided in half and the number of twists per inch counted the end attached to the seed contained the smaller number of twists per inch.

5. A study of the distribution of cotton fibers on the seed and its relation to the veination of the seed coat. This project has been outlined and the material secured for coöperative work with J. H. Moore, graduate student. The project is to be completed in the spring.

6. A comparison of physical characters of cotton fibers from two varieties of cotton grown in states of the Southwest and in North Carolina. This project has been outlined and material secured for coöperative work with G. L. Winchester. The project is to be completed by May 1.

7. In connection with the above project a coöperative project with the State College Textile School has been outlined. This work consists of spinning tests with inch and a sixteenth cotton produced in the Southwest and in North Carolina.

HATCH PROJECTS

The following are Hatch projects in progress at the Central Station:

In recent years the Division has had several inquiries regarding the treatment of cotton seed just previous to planting for the purpose of hastening germination. In order to answer these questions more intelligently this

project was started the past season. The seed were treated by the following methods, delinted with sulphuric acid, seed rolled in wood ashes, rolled in 15 pounds of nitrate of soda per bushel, and no treatment. Records were kept on length of time required to germinate, stand, relative earliness and yield. The delinted seed were first to germinate, those rolled in ashes second, the normal seed third, and those treated with nitrate of soda last. The nitrate of soda delayed germination approximately four days when compared with the delinted seed. The following table contains the results of stand, yield, and relative earliness of plants from seed treated by the above method.

Cotton Seed Treatment Tests

Treatment	Number of Mature Plants Per Acre	Number of Bolls Open October 9, Per Acre	Yield of Seed Cotton October 23, First Picking Per Acre	Number Bolls per Plant Open October 9
*Delinted (acid)	12,751	23,411	7,588	1.84
Rolled in ashes	13,571	20,370	676	1.50
No treatment (check)	11,029	13,694	594	1.24
†Rolled in nitrate soda	10,660	13,243	512	1.24

*Delinted. Seed delinted with sulphuric acid, washed and rolled in lime to neutralize acid.
†Nitrate of soda. Seed rolled in nitrate of soda at the rate of fiiteen pounds per bushel.

Small Grain Improvement

The small grain improvement work has consisted of increasing selections from Leap's Prolific and Blue Stem Wheat, and testing recent selections from Abruzzi rye. The pedigreed strain No. 32 from Leap's Prolific has continued to stand well on soils that produce fifteen or more bushels of wheat per acre. Seed of this strain is now being established among growers of Davie and Rowan counties. The Blue Stem is the earliest strain of wheat that has come to our attention. On account of its small growth and early maturity it has led the wheat variety tests on land that produce less than fifteen bushels per acre. The pedigreed strain of abruzzi rye selected at this Station has been a source of good seed during the past five years. It has been established in Forsyth, Rowan, and Guilford counties. The selection work is being continued to keep the strain up to standards.

Crimson Clover Source of Seed Test

Crimson clover seed from American and European sources were sown under uniform field conditions and the relative growth, earliness and yield of hay determined. The local sources of seed included samples from North Carolina, Georgia and Tennessee, and the foreign seed included six samples from

France, one from England, and one from Czechoslovakia. This work is being conducted in coöperation with the Office of Forage Crop Investigations of the Bureau of Plant Industry. The results of the past season indicate that regardless of source of seed, the earlier maturing strains are best adapted to this section of the State. The following table contains a summary of the results:

SEASON 1923-1924

Plat No.	Source of Seed	Relative Growth Condition April 11	Yield Hay	Stage Maturity May 15
1	North Carolina	60	1760	Blooms turning brown
2	Georgia	70	2000	Blooms turning brown
3	Tennessee	65	2040	Blooms turning brown
4	English	30	1360	Full bloom
5	French	40	1320	Full bloom
6	French	65	1360	Blooms turning brown
7	Czechoslovakia	60	2120	Blooms turning brown
8	French	65	1812	Blooms turning brown
9	French	70	1850	Early bloom
10	French	80	2500	Blooms turning brown
11	French	50	1800	Early bloom

Note. Harvested for hay May 15.

This project has been continued. The results should be of value in finding strains best adapted to our State and may furnish a source of seed with which to start the production of home-grown seed of this crop.

Lespedeza Strains

During the past few years lespedeza has become an important crop in the Southern Piedmont section of our State. It is now being grown extensively in Union, Anson and Stanly counties. In order to supply the County Agents and farmers of these sections with reliable information about the strains of this crop, comparisons have been made with the Tennessee, Kobe and ordinary commercial lespedeza. In previous tests the Tennessee strain has proved superior in growth to the ordinary lespedeza. In the current year's test the Tennessee strain has given more upright growth than the Kobe strain and did not fail so soon in the fall.

Vetch Varieties

Plantings were made of Woolly Podd, Hungarian, and Purple vetches for determining their relative growth and earliness. All of these vetches were damaged by cold though the Woolly Podded vetch stood up best. New seed of the Hungarian vetch have been secured from plantings that were made under more severe winter conditions and the work continued this fall.

Cotton Culture

The spacing tests of cotton have been continued though the unfavorable spring weather caused too many breaks in the stand to get a fair comparison this season. In last season's tests the eight-inch spacing yielded higher than plats having no thinning, twelve, eighteen and twenty-four inch spacing.

Cotton Seed Improvement

The cotton seed improvement work for the past season included studies of yield and lint characters of four strains isolated from Mexican Big Boll No. 6. Records have been kept of the time of blooming and relative amount of fruit set early in the season. In this respect strain 6-1-9 has been superior to the other three. Strain 6-1-9 has also given a more uniform length of 1-1/16 staple. Sufficient seed of this strain have been saved to plant thirty acres next year.

Sorghum Seed Improvement

The work with sorghums was started during the war when there was a scarcity of sugar. In the variety tests at that time the Honey or Japanese seeded Ribbon cane was the highest yielder of juice syrup. Seed were secured and selection work was started with this variety. Last year the selections showed considerable difference in earliness and production. The lowest yielding strain produced at the rate of 84.4 gallons of syrup per acre and the highest yielding strain 147.5 gallons. Four of the best strains have been continued this season and one of this lot has been chosen for further increase. On account of the lack of interest in sorghums for syrup production this project will be discontinued. On account of the high tonnage yields of silage from the best strain, it will be established in the eastern part of the State for that purpose, and the strain perpetuated by saving small quantities of seed each year.

Soybean Seed Improvement

The pedigreed strains of Mammoth Yellow 101, Virginia No. 11, and the Herman soybeans have continued to be leaders in their class. In a small way these strains are gradually becoming established among seed growers of the State.

Soybean Varieties

During the past season twelve standard varieties and thirty-five selections from varieties and hybrids have been included in the variety tests. Among the new strains that have shown promise are: One of Laredo, and a yellow seeded strain selected from a hybrid between Virginia and Haberlandt. This strain has plant characters like Virginia and the seed color like the Haberlandt.

Soybean Selection for Increased Oil Content

This work has consisted of comparisons of pure lines of Mammoth Yellow for yield of seed and oil content. The high oil strains proved to be so much lower in yield that they did not produce as much oil per acre as the high

yielding strains of medium oil content. The work has been narrowed down to the increase of two high yielding strains of medium oil content and one strain having a high oil content. The results of previous work are being prepared for publication.

UPPER COASTAL BRANCH STATION, ROCKY MOUNT

The following is a summary of the work and results with field crops at the Upper Coastal Plain Branch Station during the past season:

COTTON CULTURE EXPERIMENTS

The cotton culture experiments have included spacing tests, date of seeding tests, and a comparison of early bedding with fresh bedding for cotton.

Date of Planting Cotton

Date of Planting	Number of Plants Per Plat.	Average Yield in Pounds Seed Cotton Per Plat of 1—34 Acre
April 9	198	26.25
April 19	272	42.25
April 30	375	43.75
May 10	288	38.75

During the past season plantings made on April 19 and 30 have given the highest yields. The stand of the early seedings was considerably reduced by unfavorable weather. The April 30 seeding yielded at the rate of 255 pounds of seed cotton per acre more than the April 9 seeding.

Preparation Test

The preparation tests were started the past season with the hope of finding some method of securing a better stand of cotton and reducing the death rate of young seedlings during unfavorable spring weather. For this purpose plats were prepared two weeks before planting by breaking, running rows, applying fertilizer and bedding. These plats were allowed to stand until planting time when other plats were prepared fresh by the usual method. The following table contains the results from the current year's test:

PREPARATION TEST

Time of Bedding	Number of Plants Per Plat	Yield Seed Cotton Pounds Per 1—34 Acre
Early bedding	352	37.50
Bedded fresh	340	31.75

For the past season the early bedding produced at the rate of 195 pounds of seed cotton per acre more than the freshly-bedded plats. The results represent the average for three plats.

Cotton Seed Treatment

The seed treatment tests included comparisons of graded and ungraded seed, seed delinted with sulphuric acid, and seed treated with varying amounts of nitrate of soda before planting. The following table contains the results of these tests:

Cotton Seed Treatment Test

Nature of Treatment	Number of Matured Plants Per Plat	Yield in Seed Cotton, Pounds Per Plat of 1—34 Acre
Nitrate soda, 6 pounds per bushel	520	33.50
Nitrate soda, 12 pounds per bushel	435	35.25
Nitrate soda, 18 pounds per bushel	350	33.75
Check (No treatment)	361	35.63
Delinted (Sulphuric acid)	427	43.00
Ungraded seed	362	33.75
Graded seed	382	39.50

The nitrate of soda treatment delayed germination slightly and the heavier treatment reduced the number of plants per plat slightly. The average yield of the plats planted to graded seed represents an increase of 195.5 pounds of seed cotton per acre more than those planted to ungraded seed.

Cotton Spacing Test

In this work plats of cotton have been left without thinning and others thinned to 8, 12 and 18 inches between hills. The results this year do not quite support the results of other years in different sections of the State. On the average the plats that are not thinned have given the highest yield at the first picking. This season there was very little difference in yield and the early maturity was slightly in favor of the broad spacing.

THE TOBACCO EXPERIMENT STATION

Cotton Varieties. This project was started the past season to supply reliable information to growers of the Tobacco belt who have recently started the production of cotton. Previous results secured in their section of the State indicate that the Cleveland Big Boll and Mexican Big Boll are best adapted.

COASTAL PLAIN STATION

This work consists of the selection of seed for the improvement of one variety of field corn and one early dent corn for roasting ears.

BLACKLAND STATION

Corn Selection. The selection of corn adapted to the Muck lands of the section represented by this farm.

MISCELLANEOUS

On account of the seed improvement work of this Department on the Central and Branch Stations the following improved seed have been supplied to farmers of the State at a reasonable price: Cotton, 1,600 bushels; corn, 140 bushels; rye, 125 bushels; wheat, 80 bushels; soybeans, 80 bushels; barley, 20 bushels, and oats, 40 bushels.

Through the coöperation of the Department of Plant Breeding and the State Seed Laboratory 20,000 bushels of cotton seed intended for seed purposes were found to be very low in germination. The information was supplied to growers in time to prevent their being used for seed purposes. The condition is very much more serious this year on account of the very general demage of cotton seed by the excessive rains this fall. Unusual efforts should be made this fall and winter to test cotton seed from all sections of the State in order to prevent poor stands of cotton next spring, for the boll weevil at its worst could not cause more damage than is likely to come from the planting of the average cotton seed produced this year.

Respectfully submitted,

R. Y. WINTERS,

Plant Breeding Agronomist.

REPORT OF SOIL FERTILITY SECTION

OF THE

DIVISION OF AGRONOMY

To the Director: The work in the Division of Soil Fertility has been carried out during the past year following the plans accepted probably in 1910 and under the following heads: Soil Survey, Soil Chemistry and Soil Fertility.

SOIL SURVEY

During the year the following counties have been surveyed and typical samples of the different soil series taken: Polk, Rutherford, Greene, and Yadkin. About one-half of Wilson County and Northampton County have been done. During the winter and spring it is hoped that Wilson and Northampton counties will be finished.

Up to now 73 per cent of the State has been mapped and the soils classified in a manner so that the reports can be used to advantage by farmers, county agents, and other extension workers, teachers and business men. In fact, the reports as now gotten out are being used by the different agencies more than ever before. It is hoped that it will be possible in the next few years to have a fairly complete survey of the soils of this State.

The soil survey work is being done in coöperation with the Bureau of Soils at Washington, D. C., and there is complete harmony in the work.

As all of our soil chemistry and soil fertility studies are based on soil types it is very necessary that the type of soil be mapped accurately, in order that correct information from soil fertility and crop studies may be given to the farmer in an intelligent way.

SOIL CHEMISTRY

Studies of muck soils have been continued and the characteristics of four different types observed. One type from the experimental farm at Wenona is being investigated to determine the effect of water content and other treatment on reaction and other factors affecting the growth of plants. The results of this investigation, while interesting, are not ready for discussion at this date.

The amount of lime necessary to neutralize this soil is about 10 tons per acre, though the exact reaction is influenced by other factors besides the amount of lime added. Corn grows best on this muck soil if it is kept distinctly acid.

Lime mixed with the surface soil of the muck does not neutralize the acidity of the subsoil. In a test to determine the effect of leaching on the downward movement of the lime, it was found that within four months of treatment liming did not alter the reaction of the soil or subsoil more than an inch below the depth of application. This observation indicates the advisability of mixing lime in the soil to as great a depth as possible.

The influence on the yield of some fertilizer combinations with a green manure crop of oats was studied in the field. The outstanding indications of this test were:

A. The soil responded to single treatments in the following order from least to greatest:
   (1) Oats (Green manure).
   (2) Nitrate of soda.
   (3) Lime.
   (4) Muriate of potash.

B. All single treatments were beneficial and combinations generally increased the yield in comparison with the results of single treatments except where muriate of potash was used in connection with green manure. This test was made at Terra Ceia, and is in line with other results on the same soil. The beneficial effect of the green manure crop suggests the possibility of improving these soils by means of a suitable crop rotation.

The value of potash fertilizers on some of these extremely acid soils has indicated that potash had an influence in helping the plants to overcome the toxicity present. A series of solution cultures has shown that this property lives in certain potash salts but not in others and investigations are planned to furnish more complete evidence on this point.

Corn grown in pots filled with soil taken from the untreated plat of the lime field at Wenona gave the following significant results:

1. Liming was necessary in order to produce a crop.
2. With the surface soil limed the plants were injured by the acid subsoil.
3. The injurious effect of the acid subsoil, fertilizing elements were beneficial in the following order, from the greatest to the least.
   A. Nitrate of soda.
   B. Muriate of potash.
   C. Acid phosphate was injurious in three out of four tests.

CONCLUSIONS

Growth of corn on the Wenona type of muck soils is limited to soil acidity. Applications of lime to the surface is not fully effective as a remedy on account of the acidity of the subsoil. With the acidity of the soil and the subsoil partly neutralized by lime, beneficial effects may be had from fertilization with nitrate of soda and potash. Acid potash seems to be injurious in most instances.

THE AVAILABILITY OF ORGANIC NITROGENOUS FERTILIZERS

Tests made with 16 organic ammoniates in comparison with nitrate of soda, sulphate of ammonia and nitrate of potash on a soil which is, in the field, deficient in nitrogen gave inconclusive results, the unfertilized soils yielding more than many of the fertilized soils. This was attributed to the effects of excessive rainfall which doubtless leached much of the available nitrogen out of the soil and to the fact that drying the soil in preparation for placing in pots, undoubtedly increased its productivity. Treatments have been renewed and rape planted in order, if possible, to get additional results before spring.

AVAILABILITY OF SOIL POTASH

Studies of the availability of potash in soil minerals have been continued but no results obtained for the reason that the soil when first placed in the pots did not show a deficiency of potash. Continued cropping has depleted the soil to some extent and it is possible that further work will be more successful.

CHEMICAL COMPOSITION OF SOIL TYPES

The analyses of samples of soil obtained from the soil survey has been held up for some time owing to inadequate facilities for the work. About 300 samples have been received since the analytical work was discontinued. It will require several months to complete the analyses of these soils if no other work is done.

SOIL FERTILITY

During the year the soil-fertility investigations have been continued at the following experimental farms: Central Station farm, Raleigh; Mountain Branch Station farm, Swannanoa; Piedmont Branch Station farm, Statesville; Black Land Station farm, Wenona; Coastal Plain Station farm, Willard, and Tobacco Station farm, Oxford.

Project No. 1. To determine the amount of fertilizer for different crops and the best proportion in which to use the different plant foods.

At the Mountain Station farm the results showed that nitrogen, phosphates, and lime were the limiting factors. At the Piedmont Station, phosphate, nitrogen and lime were the limiting factors. Potash on general field crops does not pay. In all cases where legumes are used applications of limestone are essential. At the Central farm nitrogen is the limiting factor, with phosphate and some potash necessary for the growing of cotton. At the Upper Coastal Plains farm nitrogen and potash are the first limiting factors, while phosphate and lime are next when a good crop rotation is followed. This applies to the Coastal Plain farm also.

For most of the farms the average application of fertilizer is from 800 to 1,000 pounds per acre, this has given larger net returns than the smaller applications. On crops like cotton and tobacco, farmers of the State have not been using on an average, as much plant food per acre as is necessary to give the best results.

Project No. 2. A study of the efficiency of different carriers of nitrogen on typical types of soil, using the ordinary field crops as a measure.

This project has been conducted on the Piedmont, Central, and Upper Coastal Plain Stations. In general the inorganic carriers have given larger crop yields than have the organic materials. In practically every case with different crops and on different soil types, nitrate of soda has given a larger yield than has any other material studied. In most cases sulphate of ammonia has stood second. With the organic materials cottonseed meal has stood high and is one of the best materials to use for organic sources. On account of the high price of organic materials, partly caused by the competition as a feed for animals, the inorganic sources of nitrogen are cheaper per unit of nitrogen than the organic sources. As they are also more efficient for general crops it seems wise to impress upon the farmers the value of these materials.

Project No. 3. Crop Rotating project to determine the best rotations for the different soil provinces of the State.

On this project many crop rotations are included in order to determine for the farmers the crops that are best suited for this particular type of farming and to keep up the fertility of the soil. Most of the rotations include legumes both winter and summer, in order to furnish organic matter to the soil and to hold the surface soil from washing. In all cases it is found that legumes, when turned under are beneficial on some soils to greater extent than others. These studies are still being continued to furnish more data.

Project No. 4. Comparison of efficiencies of the different phosphate carriers that are used in the State.

This project is being carried on at the Mountain Station, Piedmont Station, Central Station, Upper Coastal Plains Station, Coastal Plains Station, and Black Land Station. So far the results indicate fairly conclusively that acid phosphate is the most efficient carrier of phosphoric acid, with Basic Slag a close second. On the average type of soils and crop rotations including red clover, the Basic Slag is showing up very well. Rock phosphate has never given as good results as had been expected under certain farming conditions, which included the use of stable manure and green manure. The soft phosphate which has appeared on the North Carolina markets has about the same value as the raw rock phosphate or floats.

Project No. 5. To study the value of different fertilizer constituents in growing Irish potatoes in the mountains.

The results so far indicate that the farmers are not using enough fertilizers for the largest and most profitable yields in growing Irish potatoes in the mountains. The value of potash is also being shown. So far the sulphate of potash has given a larger yield and somewhat smoother potatoes than the muriate of potash or kainit. On some of the plats in this project lime has been used and in each case the potatoes are extremely scabby. In crop rotations in which lime is used to get a good catch of red clover the farmers are advised to grow potatoes as far away from the clover crop as possible.

Project No. 6.

At the Upper Coastal Plains Station farm we are studying many different fertilizer formula for cotton grown under boll weevil conditions. So far the results have shown that the advice given to the farmers for growing cotton before the boll weevil came is still probably the best formula to use under boll weevil conditions. The results also show phosphates do have some effect on earliness of cotton. With the addition of too much nitrogen or too much potash the maturity of the cotton is retarded. Putting on all of the fertilizer before planting seems to give as good results as does the division of the fertilizer application, or dividing the nitrogen in the fertilizer, putting on a part at the time of planting and a part later.

Project No. 7. To study the effect of phosphate and lime applied to piedmont soils without the addition of nitrogen on crop yields in a rotation which includes a legume crop grown and turned under each year.

As this soil is in need of nitrogen for increased crops the results so far show that the nitrogen supply can be maintained by this method and successful crops grown without the use of commercial nitrogen.

Project No. 8. Cotton Fertilization on miscellaneous soil types.

We have conducted many different cotton experiments throughout the State to determine for the farmers and to get additional information on the value of different fertilizer formulas for the growing of cotton. In these experiments about 800 pounds of fertilizer has given the best results. About 8 to 10 per cent phosphate seems to be as efficient as larger quantities. About 2 to 4 per cent potash seems to supply the needs of the different soils and keep the crops in a healthy condition.

Project No. 9. To study the value of potash applications on clay soils after a red clover crop had been turned into the soil.

The results so far indicate that there is no need to apply potash for increased yields under these conditions.

Project No. 10. To study the effect of potash on crops which disease badly.

In this study it has been shown conclusively on black soil in the eastern part of the State, slate soil in the south, and clay soil in the west, that an application of 4 to 6 per cent potash in the fertilizer mixture has a very beneficial effect on the yield of corn on these soils which are subject to disease.

SOIL ACIDITY WORK

During the year we have received and reported on several hundred samples of soil sent in by farmers and county agents. In the examination of these samples of soil we have found in practically every case where the soil has not previously received lime that the soils were acid, taking from 1,000 to 3,000 pounds to neutralize the acidity. When writing to the farmers regarding these soils we have called attention to how best to use lime, the proper crop rotation, and the intelligent use of fertilizer for the crops they are growing. We feel that this work has been of immense value to the farmers and that in the future this kind of work will be on the increase.

CORRESPONDENCE

During the year there has been a very large request from farmers asking for information on the intelligent use of fertilizers for specific crops and definite soils, also the home-mixing of fertilizers. In this correspondence we have taken occasion to call attention to the value of high grade fertilizers as compared to lower grade fertilizers, also the value of soluble nitrogenous materials in comparison with the organic nitrogenous materials.

PUBLICATIONS

During this year many special articles have been prepared for the newspapers of the State on some phases of soil fertility work and a bulletin on the Results of Fertilizer Experiments with Cotton and Irish Potatoes on the Principal Soil Types of North Carolina, has been printed and distributed.

Respectfully submitted,

W. F. PATE,

Soil Fertility Agronomist.

REPORT OF ANIMAL INDUSTRY DIVISION

To the Director: I am handing you herewith a summary of the work performed by Animal Industry workers embracing research activities during the past fiscal year beginning December 1, 1923, and ending November 30, 1924. Each worker has a number of definitely outlined projects and it can thus be visualized without difficulty the magnitude of the work under way.

The Division has twenty-nine definitely outlined projects in livestock research. The information given in this report is merely a brief outline cov-

Number 1 shows a 24-pound stunted pig fed peanut meal with deficient minerals and vitamins supplied.

ering the various projects, giving the high lights in each, with a statement of progress or results obtained as the case may be.

The following is the report by offices embraced in the Division:

ANIMAL NUTRITION

J. O. Halverson, *In charge.*
F. W. Sherwood, *Assistant.*
H. A. Dickert, *Assistant.**

The following soft pork studies as reported by Dr. Halverson, are in cooperation with Mr. Hostetler, in charge of Swine Investigations:

SOFT PORK INVESTIGATIONS

(a) Soft Pork Experiment IX. This work was conducted for the purpose of determining the effect of various amounts of peanuts on the body carcasses of young weaned pigs which were fed individually on the above ration for a period of five months.

In this work it was determined that there was a very marked softening effect on the carcasses of young pigs when fed a peanut ration. The determination of this fact is of great economic importance since a large portion of eastern North Carolina is well adapted for the growing of peanuts. The determination of this fact is also a step toward overcoming the ultimate consequences of softening feeds when fed to hogs.

(b) Soft Pork Experiment X. In this study different methods of feeding peanuts and hardening feeds were tried. It is a known fact that such feeds as peanuts and soja beans produce soft carcasses and that these effects can be overcome in a measure at least by feeding such rations as corn, digester tankage and rice products.

Number 2 shows the same pig weighing 159 pounds at the end of 148 days on peanut meal feeding. The peanut constituted the only source of protein for growth.

In this particular study three of the pigs fed according to farm practice killed hard. The other group graded medium hard. All of them passed market requirements, the results, therefore, being very satisfactory.

(c) Soft Pork Experiment XI. Eight pigs of an approximate weight of 90 pounds each were fed individually on peanuts in varying amounts from one and one-half months to three months to determine the quantity of peanuts required to make a pig kill soft.

The results of this work show that there was a varying degree of softness, depending upon the length of time fed. In other words, there was a gradual softening of the carcasses as they grew heavier and the period of peanut feeding was extended.

(d) Soft Pork Studies XII. This study to determine the effect of different methods of feeding peanuts and hardening feeds on the carcasses of hogs is similar to the Soft Pork Experiment X and VII. Six pigs one-half as large as those used in Experiment X were fed for three months. All killed hard or medium hard after receiving as much as 140 pounds of shelled peanuts. Results are satisfactory. Chemical work on this experiment, however, has not been completed.

(e) Soft Pork Experiment XIII. This experiment is to study the effect of peanuts on gestation, lactation, growth, and the condition of the carcasses of pigs grown to a considerable size. Inasmuch as this work is in progress no conclusive report can be made showing results.

THE EFFECT OF COTTONSEED MEAL AND HULLS ON BREEDING, GESTATION, LACTATION AND GROWTH OF CATTLE

This project is in coöperation with Mr. Vernon M. Williams from May 1st last, and Mr. R. S. Curtis, in charge of dairy cattle and beef cattle investigations, respectively.

The plan of this work and the object in view is to determine definitely the amounts of cottonseed meal which can be fed under normal conditions to animals having in mind the effects on the above mentioned factors or conditions. It is well known that the amounts of cottonseed meal which can be fed are limited. This has been attributed to toxicity in the meal and the purpose of this experiment is to work out definitely the causes and then undertake to remedy the defects or deficiencies.

This work has been continued for a second gestation and lactation period on fifteen cows, five of which were heifers. During these two years supplements have been fed with cottonseed meal with the following results:

It can be stated definitely that during these two years work with supplementary feeds more cottonseed meal has been fed to these cows than previously, the cottonseed meal averaging approximately 86.2 per cent of the total grain ration consumed. Some striking results have been obtained in breeding, lactation, production of live calves and raised them on their mother's milk with nothing but corn husks for roughage.

No convulsions or deaths have occurred during the period when supplements were fed. Some of the cows have gradually declined in weight and gone off feed. The adjustment of the proper amount of supplements and the proper balancing of these rations with cottonseed meal and hulls is difficult and therefore more work is required.

The results of this work are very gratifying and justify pursuing it until facts are definitely established.

ONION FLAVOR IN MILK

This work was conducted in coöperation with Mr. Stanley Combs, formerly in charge of Dairy Cattle Investigations. This work was for the purpose of determining the effect of Mrs. Lea's Milk and Butter Purifier, a proprietary mixture on milk flavored with onions. The results have been published and are cited at the close of this section of the report.

THE NUTRITION QUALITY OF BUTTER FROM COWS FED ON DRY FEEDS AND ON SUMMER PASTURE

This project is being pursued. Albino rats are used and fed on highly purified rations to determine the effect of butter produced from cows made under the above conditions.

MINERAL SUPPLEMENTS, CHIEFLY CALCIUM, IN RELATION TO THE MIXED FEEDS FOR FARM ANIMALS

This project on mixed feeds and their byproducts has been pursued for two years and the results published, the citation following.

THE NUTRITIVE VALUE OF PEANUTS

(a) This study of the effect on reproduction is being pursued on small animals. In this case albino rats are used. The peanut meal used is obtained from the Protein Laboratory, Bureau of Chemistry, U. S. Department of Agriculture.

(b) This study is also being pursued on a sow during gestation and lactation. The sow produced 13 pigs under these conditions of feed. Eleven lived, nine of which are still living and the mother is being maintained on the same ration.

Note. I would like to add that work of the nature that Dr. Halverson is pursuing is usually involved, and it is therefore difficult to give a satisfactory report, this being especially true in case of those who are looking for conclusive statements.

The field of nutrition is new when considered in the light of actively pursuing the many problems confronting Animal Industry workers. It should be remembered that the economic importance of the above problems are such that it would be a most profound mistake to give out statements until every angle of the various problems under way is searched out diligently. This is merely offered for explanation to aid the reader in considering these studies.

PUBLICATIONS, 1924

(a) The Calcium Requirements of Animals in Relation to the Calcium Content of Feeds, by J. O. Halverson, and L. M. Nixon, Commercial Feeds, 1923. The Bulletin of North Carolina Department of Agriculture, June, 1924, page 25.

(b) Onion Milk Investigations—Mrs. Lea's Milk and Butter Purifier, Stanley Combs and J. O. Halverson. The Bulletin, Commercial Feeds, 1923, N. C. Department of Agriculture, June, 1924, page 18.

(c) Minerals in Animal Nutrition, J. O. Halverson, Association of Feed Control Officials, Washington, D. C. October 23, 1924.

(d) The Calcium Requirements of Farm Animals, J. O. Halverson, Flour and Feed, Vol. XXV. November, 1924, No. 6.

(e) The Lime Content in Feeds in Relation to the Requirements of Farm Animals, J. O. Halverson and L. M. Nixon, Flour and Feed, XXV. November, 1924, No. 6.

(f) The Chemical Analysis of Okra Seed (Hibiscus esculentus), B. Naiman and L. M. Nixon, American Chemical Society, Local Section, Trinity College, Durham, May 3, 1924.

(g) Soft Pork and Its Causes I: Some Results of Soft Pork Investigations II: J. O. Halverson and Earl Hostetler, N. C. Academy of Science, May 2, 1924.

(h) Notes on Gossypol, F. W. Sherwood, N. C. Academy of Science, May 2, 1924.

(i) Vitality of Albino Rats for Experimental Purposes, F. W. Sherwood, N. C. Academy of Science, May 3, 1924.

These pigs averaged 200 lbs. at 196 days old. They were fed on corn and tankage and allowed to graze oat pasture followed by soybean pasture. They made an average daily gain of 1.4 pounds and consumed 370 pounds of grain for each 100 pounds gain.

SWINE INVESTIGATIONS

Earl H. Hostetler, *In charge.*
L. H. McKay, *Assistant.*

This office has been actively engaged in conducting Swine Research work at the Swine Research Farm, Raleigh, and at four of the Branch Experiment Stations, namely: Piedmont, Black Land, Upper Coastal Plains, and Coastal Plains. A project is outlined for the Tobacco and Mountain Stations and the work will probably be started by January 1, 1925.

Considerable new physical equipment has been installed at all of the farms and we have, therefore, been able to do more and better work than heretofore.

On September 1, 1924, Mr. L. H. McKay was secured to do research and teaching work with swine.

The following is a report of the projects under way and the results obtained:

SWINE RESEARCH FARM, RALEIGH

J. T. KEESEE, *Superintendent and Herdsman.*

There are four main projects being carried on at this farm with a herd of pure bred Duroc-Jersey swine as follows:

1. Value of Pastures for Pigs.

(a) Object. The object of this work was to determine the cost of carrying pigs from weaning age to 200 pounds with and without pasture.

(b) Plan. The plan was to use 56 weaned pigs and divide them equally into six lots of eight pigs each except lots 6 which had 16 pigs, as follows:

Lot 1. Self-fed in dry lot.
Lot 2. 3 per cent grain with permanent pasture.
Lot 3. Grain self-fed with permanent pasture.
Lot 4. Grain self-fed with temporary pasture.
Lot 5. 3 per cent grain with temporary pasture.
Lot 6. 2 per cent grain with temporary pasture.

The permanent pasture consisted of orchard grass and clovers and the temporary pastures of oats followed by soybeans.

(c) Results. Lots 1, 3 and 4 required approximately the same number of days to reach 200 pounds in weight. Lots 2, 5, and 6 will not reach the required weight until after October 1st. Therefore, the results are not only incomplete but a report giving conclusions at this time is out of question.

2. Soft Pork (Coöperation with Dr. J. O. Halverson).

(a) Object. To determine the effects upon the carcasses of pigs of a given weight when fed varying amounts of peanuts.

To determine the effect upon the carcasses of pigs of a given weight when fed peanuts and rice by different methods.

To determine the effect upon carcasses of pigs, the dams of which have been fed peanuts during the gestation period.

(b) Plan. The plan was to feed 8 pigs of a given weight on varying amounts of peanuts, each pig to be fed individually.

Second. To feed 6 seventy-five pound pigs an equal amount of rice and peanuts. Three of the pigs were fed both kinds of feeds after they had been thoroughly mixed and the other three were fed the feeds separately.

Third, to feed one sow a peanut ration during the gestation and suckling periods, and feed the litter of pigs on rice after they had been weaned.

(c) Results. It was found that different amounts of peanuts in the ration affected the carcasses at slaughtering time.

The pigs that were fed peanuts and rice separately "Killed Harder" than those that were fed the two feeds mixed together.

The sow on the last phase of the experiment is not due to farrow until after October 1st. No definite statements can, therefore, be made at this time.

3. Soft Pork (Coöperation with Bureau of Animal Industry).

(a) Objects. The object of this work was to determine the effect of feeding peanuts for eight weeks with a subsequent feeding on corn and brewer's rice for twenty weeks on the carcasses of 65 pound pigs.

(b) Plan. The plan of this work was to feed twenty-seven pigs on peanuts for eight weeks after which three were killed and the other 24 pigs divided into two equal lots of twelve each. Lot 1 was fed a ration of shelled corn for twenty-weeks and lot two a ration of brewers' rice for twenty weeks.

Three pigs of each lot were slaughtered at the end of each four weeks period, beginning with the 56th day on corn and brewers' rice.

(c) Results. The three pigs slaughtered after being fed on peanuts for 8 weeks killed soft and oily. The majority of the other pigs produced satisfactory carcasses.

4. Cost of Raising Pigs to Weaning Time.

(a) Object. The object of this work was to determine the cost of raising pigs to weaning age of eight weeks.

(b) Plan. All cost records are kept on the sows in the herd, both during their suckling and dry periods.

(c) Results. This work is still in progress and due to the many factors and conditions involved definite conclusions can not be drawn at this time.

UPPER COASTAL PLAINS BRANCH STATION, ROCKY MOUNT

R. E. Currin, Jr., *Superintendent.*
L. A. Page, *Herdsman.*

A herd of twelve pure bred Hampshire sows and one boar are kept at this farm and the experimental work is carried on with the offspring from these animals. The work is planned so that two carloads of hogs can be shipped from the farm each year.

Two fundamental lines are being conducted, namely: (a) Cost of raising pigs to weaning time; (b) Determining the value of different grazing from mature weaning pigs.

1. Grazing Crops.

Corn and soybeans grown together.

(a) Object. The object of this work is to determine the amount of pork produced per acre when the crops are "hogged off."

(b) Plan. The plan was to allow 52 weaned pigs to harvest 2.8 acres of corn and soybeans grown together.

(c) Results. The results show that one acre of the above crop with the addition of 143 pounds of fish meal, produced 838 pounds of pork.

Harvesting soft, immature corn by hogs.

(a) Object. The object of this work was to determine the value of young immature corn when "hogged off" by pigs.

(b) Plan. The plan was to allow 20 eighty-three pound pigs to harvest 1.63 acres of immature corn. The pigs were turned in on the crop when the corn was in the dough stage.

(c) Results. The results show that 28 days were required for twenty pigs to harvest 1.63 acres of the above crop. After adding 100 pounds of fish meal and 21 pounds of mineral mixture one acre of young immature corn produced 457 pounds of pork.

2. Cost of Raising Pigs to Weaning Time.

The object, plan and results so far secured from this work are the same as those at the Swine Research farm where similar work is being conducted. A report was made on the results of work at Raleigh under Section 4 preceding.

BLACKLAND BRANCH STATION, WENONA

J. L. REA, JR., *Superintendent.*
A. P. LEFEVERS, *Herdsman.*

A herd of pure bred Poland Chinas is kept on this farm. The herd consists of one boar and twelve sows. The offspring from this herd is used as a basis for experimental work. Two car loads of hogs are shipped from the farm each year, one in the spring and one in the fall.

Three projects are carried out on this farm, namely: (a) Grazing crops; (b) Dry lot feeding; and (c) Cost of raising pigs to weaning time.

1. Grazing Crop Experiments with Soybeans.

(a) Objects. The object of this work was to determine the amount of pork produced from a given area of soybeans when supplemented with a 2 per cent ration of corn.

(b) Plan. The plan was to graze 45 eighty-pound pigs on three acres of Virginia soybeans supplemented with shelled corn.

(c) Results. This work showed that one acre of soybeans with the addition of 337 pounds of corn and 21 pounds of mineral produced 395 pounds of pork. The yield of soybeans was rather low and the 45 pigs consumed

2. Dry Lot Feeding.

Soybean meal versus fish meal.

(a) Object. This work was conducted to determine the comparative value of soybean meal and fish meal when fed as supplements to corn in a dry lot.

(b) Plan. The plan was to divide 52 ninety-pound pigs into two equal lots, feeding shelled corn, fish meal and mineral to Lot 1, and shelled corn, soy bean meal and mineral to the hogs in Lot No. 2. Each lot of hogs was fed these different feeds in separate compartments of self feeders.

(c) Results. The results show that the pigs in Lot 2 consumed three times as much of the protein supplement as the pigs in Lot 1. However, the total feed consumed per 100 pounds gain was approximately the same in each lot.

The above work was conducted during the spring of 1924. During the summer of the same year the work was repeated. The results of the summer work show that the pigs in Lot 2 fed on soybean meal and made less gains and required 58 pounds more of feed to produce 100 pounds gain than the pigs in Lot 1, which received fish meal.

3. Cost of Raising Pigs to Weaning Time.

The object, plan and results of this work are again the same as that conducted on the Swine Research farm at Raleigh. This work is being repeated at several of the stations to corroborate conclusions and eliminate error in so far as possible. In addition, conducting this work at the various farms will give an opportunity to determine which section of the State is from all viewpoints the best adapted to producing high class hogs that will pass the market requirements. This determination is especially needed in this State because of the soft producing feeds which are factors in pork production.

PIEDMONT BRANCH STATION, STATESVILLE

F. T. Meacham, *Superintendent.*
G. A. Berry, *Herdsman.*

A herd consisting of eight pure bred Poland China sows and one pure bred Poland China boar is maintained on this farm. The offspring from these animals are used for experimental work and for herd development.

The two principal projects with swine at this farm are (a) Grazing Crop Studies, and (b) Cost of Raising Pigs to Weaning time.

1. Grazing Experiments with Red Clover.

(a) Object. The object of this work was to determine the value of red clover for pigs when supplemented with corn and fish meal fed from a self-feeder.

(b) Plan. Twenty-five spring-farrowed pigs were used weighing about 35 pounds each. They were divided into equal lots, one lot receiving shelled corn, shorts, fish meal and mineral in separate compartments of a self-feeder in a dry lot. The pigs in Lot 2 were fed the same feeds in the same manner and in addition they were grazed on red clover pasture instead of being kept in a dry lot.

(c) Results. The results show that the pigs in Lot 2 required 319 pounds of grain in addition to the clover pasture to make 100 pounds of gain.

2. Cost of Raising Pigs to Weaning Time.

This is again a repetition of a similar piece of work being conducted on the Swine Research Farm at Raleigh. Much valuable data is being assembled on this problem which will be published after definite conclusions are drawn.

COASTAL PLAINS BRANCH STATION, WILLARD.

CHARLES DEARING, *Superintendent*

One swine project is being conducted at this farm and the same kind of work will be inaugurated at the Tobacco and Mountain Branch Stations in the near future.

The following is the outline of the work under way:

1. The Family Sow.

(a) Object. The object of this work is to determine the cost of maintaining two pure bred sows and one pure bred boar under general farm conditions where all possible feed wastes are utilized.

(b) Plan. The plan of this work is to maintain a community herd boar and furnish service at a nominal charge. This will be in addition to the use made of the boar and the project outlined. The pigs produced each year will be used for harvesting waste field products. When they are finished they will be used to furnish the home meat supply. Those that are not needed for home consumption will be sold either as breeding animals or for pork, depending on their adaptability for these purposes.

(c) Results. No results as yet have been obtained on this project as the work was only started late in the year.

ARTICLES PUBLISHED ON SWINE PRODUCTION

(a) The Home Supply of Pork.
(b) Give the Pigs a Fair Start.
(c) Pastures for Swine.
(d) Cotton (To Feed) Work Animals.
(e) Cottonseed Meal for Work Animals.
(f) Report of Coöperative Soft Pork Work.
(g) Curing Pork at Home.
(h) Soybean Meal versus Fish Meal for Fattening Pigs.
(i) Hard or Soft Pork.
(j) Report of Corn and Soybeans Hogged Off.

MEETINGS ATTENDED

During the year several important meetings were attended, among these being the Soft Pork Conference held in April at Knoxville, Tenn. Representatives from twelve states were at this meeting. Mr. Hostetler was on several important committees.

LETTERS WRITTEN

During the year 516 letters were written on subjects pertaining to swine production, judging, feeding and management.

DAIRY CATTLE INVESTIGATIONS

VERNON M. WILLIAMS, *In Charge.*

The experimental work conducted by this office will be reported on a basis of the following covering the major projects which are being conducted.

I. General Statement.
II. Central Experiment Station.
A. Cottonseed Meal Investigations.
(1) Effect of heavy cottonseed meal feeding on reproduction and lactation of the dairy cow.
(2) Corn silage as a protective factor in heavy cottonseed meal feeding to dairy cattle.
(3) Corn silage and cracked corn as protective factor in heavy cottonseed meal feeding to dairy cattle.
(4) Effect of heavy cottonseed meal feeding on the growth and health of calves receiving milk from cows so fed.
B. Corn Plant Feeding Investigations.
(1) Effect of feeding rations solely from the corn plant on the reproduction and lactation of the dairy cow.
(2) Effect of feeding rations solely from the corn plant on the growth and health of calves receiving milk from cows so fed.
III. Coastal Plains Branch Experiment Station.
IV. Mountain Branch Experiment Station.

GENERAL STATEMENT

The work of the Office of Dairy Investigations is actively carried on at three Stations: The Central Experiment Station at Raleigh, the Coastal Plains Branch Experiment Station at Willard, and the Mountain Branch Experiment Station at Swannanoa.

The work at the Central Experiment Station is carried on in coöperation with the Office of Animal Nutrition and the Office of Beef Cattle Investigations.

On January 1, 1924, the resignation of Mr. Stanley Combs, formerly in charge of this office, went into effect and the work was under the supervision of the coöperating officers until May 1, 1924, when Mr. Vernon M. Williams took charge.

No major changes have been made in the physical equipment at the three stations.

The office has had the full coöperation of the other officers of the Animal Industry Division in obtaining materials and data.

CENTRAL EXPERIMENT STATION

A. Cottonseed Meal Feedings Investigations

(1) *Effect of Heavy Cottonseed Meal Feeding on Reproduction and Lactation of Dairy Cow.*

For years, cottonseed meal has generally been considered harmful when fed in large amounts to dairy cattle. Much has been said in regard to the poisonous qualities of this feed. Some of the foremost feed authorities in the world have recommended its use only as a rich protein supplement in amounts not exceeding two or three pounds daily.

The earlier work at this and other Stations where unextracted cottonseed, cottonseed hulls and cottonseed meal were fed as the principal part of ration the cows so fed became blind, developed convulsions, aborted, gave birth to weak blind calves with soft bones and other general anatomical and physiological weaknesses.

Cottonseed meal is the cheapest rich protein dairy feed used generally throughout the South and a great part of the North and West. It is also one of the cheapest sources of energy food for cattle. Consequently the manufacturers of this meal and the men who feed it have been trying for some time to find a way to use it safely.

This station then set about to find out what was wrong with cottonseed meal and how if possible to right the wrong. For some time it was thought because of the isolation from *whole cottonseed kernel* of a poisonous substance called gossypol, that the trouble in heavy cottonseed meal feeding was due to this poisonous substance. It was later suggested that copperas feeding would offset the poison. But this suggestion did not bring success. The "poison" or "toxic" theory has been accepted rather widely over the country.

More recent work in animal nutrition has shown that certain dietary factors which although occurring in exceedingly small quantities in many natural foods play a most vitally necessary part in animal life. In view of this the Station has investigated cottonseed meal more thoroughly with regards to these dietary factors and certain mineral substances.

Certain mineral salts were added to the rations of cows whose roughage was cottonseed hulls and grain was entirely cottonseed meal. There was some improvement in the cows but the cows continued to get in bad shape, calves were born prematurely and even though some gestation periods were normal, the calves were weak, and in most cases unable to live long after birth.

Beginning in 1923 certain other supplements were added in small quantities and the result has been astonishing. Cows receiving cottonseed hulls for roughage, and a grain ration from 80 to 90 per cent cottonseed meal have produced normal calves, the calves have grown normally to weaning age on their dam's milk and the calves have produced approximately the average for dairy cows in this State. This work is not yet complete and will need to be slightly modified and continued before conclusions can be reached. It will be necessary to continue and repeat some of the work under farm conditions at the branch stations before definite recommendations can be made.

(2) *Corn Silage as a Protective Factor in Heavy Cottonseed Meal Feeding to Dairy Cattle.*

Cottonseed meal supplemented with corn silage has not proved to be a satisfactory ration. The addition of certain minerals has not proved sufficient. The addition of certain minerals and small amounts of other substances containing proteins of higher quality and rich in the food accessories has made silage and cottonseed meal apparently sufficient for reproduction and lactation not far below average.

(3) *Corn Silage and Cracked Corn as Protective Factors in Heavy Cottonseed Meal Feeding.*

Where cottonseed meal and hulls have been supplemented liberally with corn silage and cracked corn the cows receiving this ration have not been able to give birth to normal calves and milk normally. But with the addition of small quantities of certain other substances to the rations, these cows have given birth to normal calves and have milked well above the State average.

(4) *Effect of Heavy Cottonseed Meal Feeding on the Growth and Health of Calves Receiving Milk from Cows so Fed.*

In all the three experiments described above calves were fed on the milk of their dams and where calves died they were replaced with week-old calves purchased from near-by dairymen.

Up until the past year calves fed milk from the cows on the heavy cottonseed meal rations failed to make the normal growth and to resist disease as did the calves fed on milk produced by cows fed normal rations. The success in producing living calves that made normal growth is ascribed to the effect of the supplements added to the rations of the cows.

B. Corn Plant Feeding Investigations

(1) *Effect of Feeding Ration Solely from the Corn Plant on the Reproduction and Lactation of the Dairy Cow.*

It is not uncommon on some farms to feed cows throughout the winter season on corn fodder and some corn grain. This feeding system was used on four mature cows. The cows so fed developed an unthrifty appearance but would often come through the season in fair flesh. The calves, however, were sometimes born prematurely, weak, and blind. By supplementing rations of corn stover, corn silage, and crushed corn with steamed bone meal and certain highly potent sources of vitamines, fully developed calves of normal weight were obtained. And these cows produced a fair flow of milk. The cows whose rations were raised in protein by adding corn gluten meal produced considerably more than the average for the State. These results are in accord with the findings of the Wisconsin Agricultural Experiment Station and would indicate that dairy cows whose rations are largely made up of products of the corn plant should be fed some mineral compound containing calcium such as steamed bone meal or calcium carbonate at the rate of two to three pounds per hundred pounds of grain.

(2) *Effect of Feeding Rations Solely from Corn Plant as Shown by the Growth and Health of Calves Dropped by Receiving Milk from Cows so Fed.*

Until the rations of the cows described above were supplemented the calves were subnormal and of low vitality. Following the addition of these supplements normal calves were obtained which proceeded with normal growth.

COASTAL PLAINS BRANCH EXPERIMENT STATION

The herd development work has been continued at this Station. It was interfered with somewhat by the transfer of part of the herd to the Mountain branch station but the heifers now in the herd will soon bring the cow herd up to the desired number of approximately thirty-five.

There are now eight bull calves, sixteen heifers and twenty-two cows in milk. Of these twenty-two, five are heifers which freshened during the year. The other seventeen that were in the milking herd produced an average of 7,025.6 pounds of milk and 365.05 pounds of butterfat.

Three daughters of Eminent 19th completed Register of Merit records as follows:

	Number	Age at beginning	Butterfat
Pender Eminent Lass D	369039	7 years 11 months	612.21
Pender Eminent Lass Q	407986	4 years 6 months	551.87
Pender's Delia's Girl	428960	4 years 8 months	534.82

Lass G's Ola, No. 491463, a granddaughter of Eminent 19th, out of Pender Eminent Lass G and by Rumina's King, completed a very good record of 565.87 pounds of butterfat starting at two years ten months which wins an American Jersey Cattle Club Silver Medal for her and makes her State Class Champion over all breeds.

These granddaughters of Eminent 19th by Rumina King are in turn being bred to the Distinguished Eminent. This is a line bred bull out of a Gold Medal cow who was in turn sired by Gold Medal sire and out of a cow with a good Register of Merit record. He was sired by Sensational Fern and out of Eminent's Distinction, a Gold Medal cow. From a breeding standpoint then the blood of this bull should make a splendid cross on the granddaughters of Eminent 19th. When the heifers by the Distinguished Eminent shall have reached a mature age, three full mature generations will be completed in the Herd Development Project. The records of these cows will show clearly the extent to which a herd can be developed in a few years by the use of bulls whose ancestry is well filled with high production records.

MOUNTAIN BRANCH EXPERIMENT STATION

The dairy barn at this Station has been improved and the herd has become established so that research may now be carried on at this station.

The cows at this station were taken from the herd at the Coastal Plains Station and apparently are very well adapted to the conditions at their new home.

There are in this herd at present two bulls, eleven heifers and eleven cows.

These eleven cows produced an average of 7,524.3 pounds of milk and 360.78 pounds of butterfat during the past year and only six of the eleven are mature animals. The average for the State is about 3,000 pounds of milk and 135 pounds of butterfat.

All the cows in the herd are daughters or granddaughters of Eminent 19th and are being continued in the breeding studies started at the Coastal

Plains Station. One of them, Eminent's Queen Anne No. 491462, now on official test as a junior four-year-old, averaged 69.36 pounds of butterfat during her first five months on test.

MEETINGS ATTENDED

During the year several important meetings were attended, among these being the American Dairy Science Association held at Milwaukee, Wisconsin, October 6th and 7th. Representatives from the entire United States and Canada attended this meeting.

LETTERS WRITTEN

During the year approximately 1,200 letters were written on subjects pertaining to dairy cattle investigations, feeding and management.

BEEF CATTLE AND SHEEP INVESTIGATIONS

CENTRAL EXPERIMENT STATION, RALEIGH

R. S. Curtis, *In charge.*
D. W. Jones, *Herdsman.*

1. Effect of Cottonseed Meal upon Growth and Reproduction of Cows and Heifers.

Object. To determine the various residual effects from using excessive quantities of cottonseed meal when fed to cows and heifers under controlled conditions. Some of the probable results are abortion, animals with soft bones, partial and total blindness, and general oedemic conditions.

Results. Results show that various supplements such as calcium carbonate, butterfat, cod liver oil, yeast, mineral steam bone meal and wheat embryo have corrective effects. This is a long time experiment, however, and conclusive evidence on the many angles of this problem are not now available.

Note. This work is coöperative with Mr. Vernon M. Williams and Dr. J. O. Halverson, in charge of Dairy Research and Animal Nutrition, respectively.

2. Stomach Worms in Sheep.

Object. To determine the effect of grazing crops, high feeding, and specific antidotes for preventing and ridding sheep of stomach worms.

Results. Results up to date show that all three of the above have corrective effects, but as to the comparative value of each it is not justifiable in making a statement just at this time.

PIEDMONT BRANCH STATION, STATESVILLE

F. T. Meacham, *Superintendent.*
Grady A. Berry, *Herdsman.*

1. Cost of Raising Lambs to Marketable Age.

Object. To determine the cost of raising high class market lambs to marketable age and condition, using a pure bred Hampshire ram and high grade ewes of Shropshire and Merino blood.

Results. The results show conclusively that good market lambs can be produced under Piedmont North Carolina conditions with pastures, silage and cracked corn supplemented with cottonseed meal and wheat bran. All of the lambs produced have been sold in Raleigh at good prices, ranging from 15 to 20 cents per pound, depending on the year and season sold.

BLACKLAND STATION, WENONA

J. L. REA, JR., *Superintendent.*
A. P. LEFEVERS, *Herdsman.*

1. Production of Beef Cattle.

Object. To determine the success with which high grade beef cattle can be produced under Black Land conditions by using pure bred sire and common or native females, native pastures to be grown for the purpose and wintering feeds to be supplied from the farm with the possible exception of cottonseed meal.

Results. Tentative plans are just under way to inaugurate this work and as soon as the cattle tick is eradicated in the county, which will be in December, this work will be started.

COASTAL PLAINS BRANCH STATION, WILLARD

CHAS. DEARING, *Superintendent.*
THOS. H. CAMERON, *Herdsman.*

1. Permanent Pasture Studies (In coöperation with W. F. Pate, Agronomy Division).

Object. To determine the grasses which will grow best under Coastal Plains conditions, and to determine their carrying capacity with beef steers, later applications to be made with dairy cattle.

Results. Experiment outlined only and plans being made for its execution.

Note. This same work will be duplicated at the Black Land Station at Wenona.

MEETINGS ATTENDED

The most important meeting attended during the year was the Soft Pork Conference held at Knoxville, Tenn., during April. Twelve states were represented at this meeting. The writer is also chairman of the Council of Live Stock Research for the Southern States. A report of the work conducted by this Council was reported at the meeting of the Southern Agricultural Workers held at Montgomery, Ala.

Numerous other meetings were attended throughout the State during the year. These pertained either to research or extension work.

The administrative duties of the Division consume considerable time and from this view point I wish to speak a word in regard to the splendid progress which has been made during the year. The morale of the Division has

been fine and I would not feel that I had performed my duty without making mention of the splendid coöperation effective among all workers.

If there is any additional information which you may desire I will be pleased to furnish it upon request.

Respectfully submitted,

R. S. CURTIS,
Animal Industry Division.

REPORT OF POULTRY INVESTIGATIONS

To the Director: Poultry research work is carried on at the Central Poultry Plant at Raleigh, at the Coastal Plains Pountry Plant at Willard, at the Mountain Poultry Plant near Swannanoa, and at the Poultry Disease Research Laboratory located at State College.

Studies conducted at the experimental plants are along three main lines: nutrition, breeding, and disease research. At the Disease Research Laboratory, at the college, there is carried on studies of disease and disease control as well as general pathological studies, parasites and survey work; also studies in normal structures and laboratory diagnosis.

THE LABORATORY RESEARCH

In addition to answering 3,375 letters, the disease section of this division also received for laboratory and hospital examination 496 birds coming from different parts of the State. The poultry hospital to which sick birds may be sent for examination and advice and the research laboratory, maintained in connection with this department, is being appreciated more every year and the demands made upon it are increasing.

Studies were continued along the lines of fowl typhoid, one of the most common of poultry diseases. During the year, 22 new outbreaks were studied. This represented a total of 2,800 birds, of which 213 had died before vaccination and only 32 after vaccination. Latest researches have shown that if the new birds and chicks are vaccinated as soon as they are the size of partridges, the rearing of poultry can be carried on successfully where the disease has made its appearance. During the year we have published the following findings in this study: "Fowl Typhoid. Its Dissemination and Control," by B. F. Kaupp and R. S. Dearstyne, Jour. Agri. Res., Vol. XXVIII, No. 1, Apr. 5, '24. This shows the epiornithological studies of two extensive outbreaks with charts giving the relations of the flocks to each other, to the public highway, and the drainage of the ground. Also the results of the experimental control measures by the use of a vaccine made from the germs isolated from the diseased birds. "Fowl Typhoid—A Comparison of Various European Strains With Those of North America," by B. F. Kaupp and R. S. Dearstyne, Poultry Science, Vol. III, No. 4, April-May, 1924." Showing pictures of a typical case in an Ancona hen, the cultures on agar slant, a photomicrograph of the organisms, lesions found on post mortem, and a temperature chart showing the temperatures of the birds after inoculation with strains of the organisms from North Carolina, California, England, France, Belgium, and Holland. There is also shown a photograph of the mucous lining of the bowel showing hemorrhages as sometimes found in cases which died of the disease.

Of studies in general pathology there were two publications, the first occurred in the "Jour. of the A. V. M. A., Vol. LXV, N. S. 18, No. 4,

July, '24," by B. F. Kaupp and R. S. Dearstyne on Poultry Pathological Studies." The first section of this study dealt with auricular dilatation of the heart of a S. C. Rhode Island Red cock, which is rare but here observed. The second was that of a horny growth occurring on the dorsum of the foot of a Barred Plymouth Rock hen, the third a study of Favus in an Ancona cock. This disease is rare in this country and is due to a fungus. A salve made of sulphur and vaseline and applied three times a week effects a cure. The fourth case is that of acute dermatitis of a S. C. White Leghorn chick. Pictures illustrating these cases are given. The second, "Pathological Studies in the Fowl, by B. F. Kaupp and R. S. Dearstyne, occurred in Veterinary Journal, London, England, Vol. 80, No. 4." The first study was that of impaction of the floating portion of the small intestines, impaction may take place at any point of the digestive tract according to these studies and may be due to many causes, among which is feeding too much coarse fiber, or a paralysis of the muscular coat of the bowal. The second study was that of an extra abdominal testicle in which a testicle had developed on the outside of the abdominal wall, just below the skin and at a point just back of the last rib. The third and last subject was generalized abscess condition or pyemia, this is reported for the first time in the fowl.

There was presented at the annual meeting of the American Association of Instructors and Investigators in Poultry Husbandry in August, 1924, held at Raleigh, an article on the "Use of Research Material in Resident Teaching and Field Teaching, by B. F. Kaupp, R. S. Dearstyne, and W. F. Armstrong. This was published in Poultry Science, Vol. IV, No. 1, Oct.-Nov., 1924." It gives in graphic form the life cycle of the tape worm—tænia infundibuliformis—in which it shows that the segments of the tapeworm voided through the droppings and the tapeworm eggs eaten by the fly from the fresh droppings, develop in the fly the larval tapeworm consisting of a head and neck. This fly is eaten by another bird and in the new host develops a tapeworm that matures in about 60 days. Similarly a graph shows that the large roundworm of the intestines, the ascaris inflaxa, passes into the fowl's intestinal tract through soiled food or water, then migrates to the liver, thence to the lungs, where after ten days it again returns to the small intestines and becomes adult in about 60 days. In a similar manner there is illustrated the cycle of spread and control of fowl typhoid, bacillary diarrhea of the chick, blackhead in turkeys, and coccidian diarrhea cycle.

Another infectious disease we have studied is that of infectious bronchopneumonia from which cases we have isolated the Diplococcus Pneumonia Capsulatus, which, so far as are able to determine, is the first time it has been isolated from the fowl.

The effect of lactic acid, as found in milk, upon the disease producing germs of fowls as the Eberthella sanguinaria of fowl typhoid, the Bacillus avicida of fowl cholera, and Bacterium pollorum of infectious diarrhea of chicks was studied. It was found that the germs of fowl typhoid would not grow in a medium or milk containing 0.7 per cent lactic acid, the germs of fowl cholera would not grow in medium containing 0.6 per cent lactic acid, and the germs of infectious diarrhea or white diarrhea would not grow in 0.6 per cent lactic acid media.

LIGHTS VS. NO LIGHTS

Lighting studies are being carried on at the Central and the Mountain Stations. It is found that 14 feeding hours, made possible by extending daylight, with the use of electric or other lights, and the proper housing and feeding, will bring springtime production, especially with pullets. The lights should be started November 1st, and continued to April 1st. On April 1st the daylight extension must be stepped down only about ten minutes a day till only normal daylight is given. If too sudden a change is made the birds will be thrown into a moult. Fourteen feeding hours for a period of 36 consecutive months resulted in the pullets laying 50 per cent more eggs the first year with a result that the check lot laid more the second year and about equal the third year. A hen must have a rest period after she has finished her year's work and gone through her moult. It is not advisable, according to our studies, to put breeding birds under lights. The value of eggs for the year from the hens under lights was $6.10 per hen and $5.13 each for hens not under lights.

MEAT MEAL VS. FISH MEAL

An experiment was run on S. C. Rhode Island Red hens in which the animal feed for one flock was fish meal and in the other meat meal. Equal amounts of animal protein was used in each case. Fish meal is found, in this test, to be the equal to the meat meal-fed flock. In each flock there was an average annual production of 27 per cent.

EFFECT OF LATITUDE ON EGG PRODUCTION

Coöperative work is being carried on between the Manitoba Agricultural College and the North Carolina Experiment Station in a study of the effects of latitude on production and development of S. C. White Leghorns at Raleigh as compared to Winnepeg, Canada. This is the fifth year of a six-year test. It is found that there are more possible hours of sunshine at Winnipeg than at Raleigh but that there are more actual hours of sunshine at Raleigh. The past year the birds at Raleigh laid 35 eggs per hen more than the other half of the flock at Winnipeg. The birds at Raleigh developed one-half pound heavier and are more loosely feathered and fleshed than at Winnipeg.

Breeding studies in egg production are still in progress. Studies show that high egg production is transmitted from sire to daughter, and from sire to son and son to daughter. We are making a study of the transmission power of the female to her daughters.

Studies have been made during the past year in the value of fish meal vs. meat meal in chick development. Fish meal replaces meat meal.

THE COASTAL PLAIN EXPERIMENTAL WORK

Great improvement has been made in the poultry plant at the Coastal Plains Station and some long time work has been started. This is testing the relative value of milk vs. meat meal in the health and productivity of a flock.

THE COST OF PUTTING S. C. RHODE ISLAND REDS INTO LAYING

In the first test the flock started out with 282 baby chicks. One hundred and twenty-one pullets remained at the end of the 30th week. At that time they were in 60 per cent production. Fifty-two died during the entire time. Eighty-seven per cent were raised. The pullets began to lay in their 20th week and laid 1,640 eggs during the time between the 20th and the 30th weeks. These eggs were sold locally and brought $52.60. Eighty-four cockerels were removed from the flock on the ninth week and these were fattened and sold for $78.75. Fourteen cockerels were later removed and sold for 90 cents each, or a total of $12.60. Eleven cockerels were kept for breeders which valued, at that time, at $2 each, were worth $22. There was used for brooding 36 gallons oil which at 14.5 cents per gallon cost $5.67. It required, to handle the feeding, 2,412 pounds mash and 2,358 pounds grain which cost $191.58, which added to the cost of the oil makes a total of $197.25. The returns from the cockerels and eggs to 30 weeks was $165.95. The birds paid all their feed and oil cost to 30 weeks of age with the exception of $31.30. The amount of feed in mash and grain per 100 chicks from the first week to the 30th week was also determined.

THE MOUNTAIN EXPERIMENTAL POULTRY PLANT

Experimental commercial poultry work is being conducted at the Mountain Station poultry plant. One commercial unit of 500 birds are housed in a half-monitor house 20x100 feet. One-half of these birds received fish meal as their animal feed and the other meat meal. The birds are lighted from November 1st to April 1st, to produce eggs when they are a high price and to shift the flush of production from spring to late fall and early winter. The first year of the experiment will be concluded November 1, 1925, when a report will be made.

It is recommended to install a cabinet mammoth incubator and conduct experimental hatchery work another year.

Other experimental work at the Mountain plant consists of a study of the effects of shell texture on hatchability. The summary of a large number of these tests show that normal shelled eggs have a high percentage hatchability and run 85.1 per cent fertile, while ridged shelled eggs run 54.9 per cent fertile, thin shelled eggs 41.6 per cent fertile, and mottled eggs 38.6 per cent. There is a difference of 46.6 per cent in the fertility of normal shelled eggs over the mottled shelled eggs, 37.8 per cent difference in fertility between the normal and ridged shelled eggs, and 57.3 per cent difference between the normal shelled eggs and the thin shelled eggs. The livability of the embryos during incubation is also greater in the normal shelled eggs.

Respectfully submitted,

B. F. KAUPP,
Chief of Division.

REPORT OF DIVISION OF ENTOMOLOGY

To the Director: Herewith is presented report on investigation work in entomology under my charge, for 1924. Before discussing the regular projects, there are several matters to which it is desired to call attention.

RECORDS OF INSECT OUTBREAKS

The writer keeps a record of the complaints of insect depredations in the State which are reported to this office. For any pest we can quickly ascertain the entire volume of complaints, by month, year, or series of years, and the localities from which they have come. This record extends through twenty-four years.

These records show that many of our insect pests are chiefly destructive in definite, limited sections of the State. Some of the cases are here stated.

Cotton Red Spider. Western edge of coastal plain and eastern edge of Piedmont.

Corn Bill Beetle. Coastal plain, chiefly.

Cotton Boll Weevil. Entire cotton era, worst east, south and southeast.

Mexican Bean Beetle. Mountain section, but spreading eastward.

Hessian Fly. Piedmont, chiefly.

Chinch Bug. Piedmont, chiefly.

Elm Leaf Beetle. Piedmont, chiefly.

San Jose Scale. Whole State, more prevalent in Piedmont.

Oyster-shell Scale. Western half of State.

Scurfy Scale. Western half, mostly in mountains.

Gloomy Scale. Most of State, but not complained of from mountains.

Imported Currant Worm. Western half, mostly in mountains.

Fall Canker-worm. Mountains exclusively, to date.

Any insect pest naturally assumes special importance in sections where its favored food-plant is grown as a commercial crop.

Pecan Twig-girdler. Most of State, complained of from eastern section.

Peach and Plum Curculio. Whole State, most important in sandhills peach section.

Codling Moth. Whole State, most important in mountain apple-growing localities.

It has long been recognized that each main section of our State has its own agricultural problems: the records just summarized show this to be true of the insect problems also.

FIELD STATIONS

Long contact with these regional insect problems and outbreaks convinced us that the needs of the farmers could best be served by locating workers at strategic points; and that the investigational work to reach its highest usefulness, should be carried on in the particular regions where each problem is most acute. This plan has been followed for some years. During the outbreak of Green Clover Worm on soybeans in 1919 temporary field stations were operated in the counties of Beaufort and Pasquotank. In 1920 a temporary field station to study Fall Canker-worm was operated in Avery. During the past three years a field station has been operated at Aberdeen in Moore County for investigations pertaining to peach insects and also boll weevil, and there is need for putting this work in the sandhills region on a permanent basis. In 1923 a temporary field station for study of the Mexican Bean Beetle was operated at Bryson City (Swain County), and with the eastward spread of the beetle these operations were conducted during 1924 at the Mountain Branch Station, Swannanoa, Buncombe County. In the extension work similar field stations have been operated to deal with the boll weevil.

In every case when I have visited the field stations I have found the workers accumulating records and data of value, and maintaining helpful contacts with farmers, county agents, and others in the section who were concerned. Citizens have repeatedly given me the most convincing testimony of the high estimation in which these operations are regarded. My own experiences at times when I have participated in the work of the field stations have also been convincing.

In cases where a branch station of our Experiment Station is located within the area concerned in an insect problem, we greatly prefer to conduct our studies at the branch station and to make them more permanent. This is being done in the work with the Mexican Bean Beetle, now located at the Mountain Branch Station. Other developments in this direction are hoped for; yet special emergencies of an epidemic nature often arise at a distance from any of the permanent branch stations, and in such cases the temporary field stations have been operated.

WORK ON APPROVED PROJECTS

In the account which follows mention is made of every project which has been formerly outlined, submitted and approved. As yet we have not officially "closed" any project, although some have been relatively inactive of late. In the case of insects which appear only in spasmodic outbreaks proper studies can be made only in such years as they may be epidemic. The workers chiefly concerned are mentioned in connection with each project.

No. 1. Pecan Insects. This has been one of the chief projects of study of Dr. R. W. Leiby during much of the past ten years. The life-histories and control of ten insects more or less injurious to the pecan have been worked out, along with additional pecan insects of minor importance. Bulletin on this subject is now being prepared.

No. 2. Larger Corn Stalk-borer. No active work since publication of Bulletin, N. C. Dept. Agriculture, August, 1920, Vol. 41, No. 13, Whole No. 274, by R. W. Leiby. An extension circular on this subject is yet to be prepared.

No. 3. Potato Spraying and Flea-beetle Control. This project has been prosecuted each year by this Division since 1913. Since 1915 it has been in charge of R. W. Leiby, assisted by Mr. S. C. Clapp in charge of Mountain Branch Station, at which place all work on the late crop has been carried out.

The average yield of potatoes in bushels per acre where they have been sprayed with the poisoned Bordeaux mixture is 170.6 bushels. Where the potatoes have not been sprayed the average yield was 117.3 bushels per acre. The average gain by spraying therefore during a ten-year test period is 53.3 bushels per acre or a gain of 45 per cent due to spraying.

The spraying experiments have not been confined to a single spraying combination. A number of different treatments were given different plats each year in the hope of finding a spray that would be better than the home-made Bordeaux mixture. During late years dusting with a copper-lime-arsenate mixture has been compared with the sprayed plats and has given even better results. However, the dust method of treatment is more expensive and should be relied upon only where spraying is impracticable.

Experiments on the early crop potatoes were also conducted from 1916 to 1920. The average yield of six tests where the vines were sprayed with the home-made Bordeaux mixture was 144 bushels per acre. Where the vines were not treated the yield averaged 70 bushels per acre. The gain shown in the six tests averaged 74 bushels per acre or 106 per cent.

The results have partially been issued in bulletins of the Department of Agriculture and extension circulars of the N. C. Agricultural Extension Service. A complete report will be issued shortly.

No. 4. Laundry Soap in Water for Aphids. (F. Sherman). No tests have been made been made during the past year on this minor project.

Years ago a field worker in testing kerosene emulsion to control Cabbage Aphis exhausted his supply of kerosene, and finished his work for the day with applications of merely soap and water, the amount of soap being increased above what would be used in the emulsion. The results were interesting. At various times tests with several other species of aphids have been made. As a result, we regard laundry soap-and-water, at strengths varying from one-half to one and one-half pounds to four gallons to be effective for most of the delicate species of aphids on flowers and vegetables. This makes a simple remedy the ingredients of which are available in every household. The exact strengths needed for different species, tolerance of foliage, relations to sunshine, etc., have not yet been covered by tests.

No. 5. Insect Survey of North Carolina. A permanent project, and one of our most active ones. Begun by Mr. F. Sherman in 1900, and operated chiefly by Mr. C. S. Brimley since 1919. Other members of the Division take part, Mr. T. B. Mitchell and Mr. J. C. Crawford being especially active during the past year.

Each species authoritatively ascertained to occur within the State is card-cataloged with entries of localities and dates of capture of adults on front

Dusting Irish potatoes on the Mountain Experiment Station. Seed of this quality have been found equal to if not superior to northern grown seed potatoes for Eastern Carolina.

of card, and map showing distribution within the State on reverse side. Collections are kept to correspond to the records so far as we can obtain specimens. Much data on food-habits, ecology, parasitism, etc., has accumulated.

These records, especially in coördination with the complaint records referred to in the opening portion of this report, each now covering nearly twenty-five years of work, give an understanding of the insect fauna, its relationships, its influences, and its problems, which we are unable to secure in any other way. This is especially helpful in view of the diverse faunal and floral conditions which are found within the State.

Our "Insect Survey" project serves as a starting point for more elaborate studies of any species or group which it is desired to investigate. The collections are drawn upon for exhibits in the State Museum, at fairs, at meetings, and are in constant use in identifying specimens which are collected or reared by our workers, or sent by correspondents for identification or under suspicion as pests. Workers outside the State often ask for items from our survey records.

On November 1, 1923, our lists showed 6,775 species of insects on record for the State. Considering (for this presentation) our insects to belong to seven main groups, we give the following showing of additions during the year:

State List of Insects (November 1, 1923)		6,775 species
Added (November 1, 1923 to November 1, 1924)—		
Orthoptera	0	
Hemiptera	18	
Neuroptera and miscellaneous	3	
Lepidoptera	7	
Diptera	58	
Coleoptera	65	
Hymenoptera	104	
Total additions for year	255	255
Total State List (November 1, 1924)		7,030 species

Similar work is also done in the groups related to the true insects, such as spiders, myriapods, etc. Our workers or others have done much work in other groups of animals. We are thus able to say with considerable accuracy that according to present records as known to us, the group of insects comprise more than 76 per cent of all the species of animals known to inhabit North Carolina. Scientists of the highest attainments have seriously advanced the idea that insects give evidence of being the most "successful" of all groups of animals, in the matter of survival of species, multiplicity of forms, adaptability of habits, and abundance of individuals; and that we may well consider seriously whether in future centuries they may prove to be our closest competitors in our natural desire to "inherit the earth."

Our insect survey project is therefore planned to investigate, at least in a general way, by accurate methods, the relationships of our entire insect population to human welfare. The few articles which we have issued through the daily papers dealing with our findings in this project have

elicited appreciative responses from school students, teachers, and also farmers.

Pertaining to this project the following papers have been published during the year:

Three Supposed New Species of Ceraturgus (Diptera, Asilidæ), by C. S Brimley, Entomological News, Vol. 35, pp. 8-12 (January, 1924).

North Carolina Odonata (Libellulidæ), by C. S. Brimley, Entomological News, Vol. 34, p. 314 (December, 1923).

No. 6. Black Corn Weevil. This work has embraced a study by Mr. T. B. Mitchell of field practices as related to weevil-injury. The findings thus far indicate that: (1) Earlier planted corn is more heavily infested with weevils than corn planted later. (2) Planting corn near weevil-infested cribs promotes weevil attack, while corn grown at a distance from such a crib is less attacked; this points to cleaning out of old cribs as a preventive measure. (3) Ears with tight husks showed relatively light weevil-infestation, while ears with loose husks showed more infestation. Data on these points have been secured.

In 1924 the farm where these studies are conducted had not suitable plantings for ample study of relation of time of planting to weevil infestation, but data was secured on points 2 and 3 as mentioned above, and in each case it was confirmatory.

No. 7. Cabbage and Collard Dusting for Worms. No additional observations made in 1924. Results of previous work have been issued in N. C. Agricultural Extension Circular No. 135, *Dusting of Cabbage and Collards to Control Worms* (January, 1923), by R. W. Leiby and S. C. Clapp. Effective control has been demonstrated by dusting every ten days with a mixture of one pound of lead arsenate with six pounds of air-slaked lime.

No. 8. Green Clover Worm on Soybeans. No serious outbreak of this insect has occurred since 1919 when intensive studies were conducted, the findings of which were published in N. C. Extension Circular 105, *Green Clover Worm as a Pest on Soybeans*, by F. Sherman and R. W. Leiby (July 1920).

While much data and splendid results were secured during the 1919 outbreak, there are points which we would like to clear up or confirm afresh should another opportunity offer.

No. 9. Army-worms (The Army-worm, and Fall Army-worm). As there have been no outbreaks, no new data was added during the year.

The experience of previous years indicates that each outbreak of the (true) Army-worm usually extends only through the brief lifetime of one generation of larvæ, and that the prompt subsidence of the outbreaks is due largely to the beneficial activities of the Red-tailed Tachina-fly parasite, *Winthemia 4-pustulata*. Careful counts of the fly-eggs on many hundreds of Army-worms together with cage-rearings, indicated that the parasite was present in such numbers and working with such activity as to secure a maximum killing of the destructive worms together with a maximum survival of the beneficial parasite. This parasite is by no means dependent upon Army-worm for its own survival, and seems to be quite abundant every year, and thus constitutes an important protective agency.

The Fall Army-worm has not appeared to be so freely attacked by parasites, and its outbreaks have continued longer, apparently through more than one generation.

No publication on this project has been issued during the year; the several papers issued in former years are as follows:

Army-worms—two kinds, pp. 35-41, Bull. of N. C. Dept. Agriculture, May 1914, by F. Sherman.

Rearing of Moths and Tachina-flies from Larvæ and Pupæ of Army-worm in North Carolina in 1914, by F. Sherman, Jour. Economic Entomology, Vol. 8, No. 2, pp. 299-302 (April, 1915).

The Fall Army-worm, by F. Sherman and R. W. Leiby, N. C. Ext. Circular No. 79 (September, 1918).

No. 10. Mosquitoes and Control. This minor project is an expansion of insect survey work, pertaining to this special group of insects. It was more active during and immediately following the war period; relatively inactive since that time. F. Sherman and R. W. Leiby have been the chief workers.

The following paper bearing on this subject was published several years ago:

Notes on the Mosquito Fauna of North Carolina, by F. Sherman, Jour. Elisha Mitchell Scientific Society (Chapel Hill, N. C.), Vol. 36, pp. 86-93 (September, 1920). This paper records the presence of thirty-two species in the State, with notes on geographical distribution and seasonal occurrence, and reviews the recognized control methods.

No. 11. Cut-worms. Mr. C. S. Brimley carries this as a minor project, the greater part of his time being given to the insect survey project. Cut-worms were comparatively scarce during the year. Data secured by Mr. Brimley in the past indicate that at Raleigh the greater part of the damage is done by three species, as follows:

1. *Feltia gladiaria.* The earliest and most destructive of our early-spring cut-worms. Only one generation each season. Adults of this species are not easily attracted to bait-traps and have seldom been found at lights. The pupæ seem to be easily killed by disturbance of the soil during the pupating period in summer; which suggests cultivation as one means of control.

2. *Variegated Cut-worm (Peridroma saucia).* Becomes active a little later in season than the preceding and is less destructive but persists throughout the season, apparently producing several generations. The moths come to bait-traps abundantly, and also are attracted to lights. The cut-worms of this species seem more susceptible to bacterial disease than the others.

3. *Granulated Cut-worm (Feltia annexa).* Has much the same life-history as the preceding, but seemingly less subject to disease, and is more noticeable as a pest of cruciferous crops in late summer and autumn. The cut-worms of this species seem more hardy than the others and are relatively easy to rear to the adult stage. Adults are common both at bait-traps and at lights.

The adult moths of ten additional species of cut-worms have been captured in bait-traps at Raleigh by Mr. Brimley, but they are apparently of lesser importance. However, the sendings of specimens which we have received with complaints from distant parts of the State indicate that in

these localities the prevailing species are probably not always the same as at Raleigh.

In operating bait-traps Mr. Brimley takes the greatest number of cutworm moths in the month of September.

As no separate publication has yet been issued pertaining to this project, we have given some details in this account.

No. 12. Cotton Boll Weevil. This project has occupied much of the time of Messrs. R. W. Leiby and J. A. Harris during the past year. Further studies of the life-history and control as ascertained at the boll weevil laboratory at Aberdeen were concentrated largely upon the natural control (climatic and insect), and artificial control by use of the calcium arsenate dust method, and one or two proprietary compounds reputed to control the weevil.

During 1924 it was found that the hibernating weevils migrated to cotton during the period of May 25 to July 1. Weevils belonging to the first generation deposited an average of 102 eggs per female during the season. Seven additional pairs deposited an average of 74 eggs per female during the latter part of the season over a period of 41 days.

A number of series of cotton squares infested with stages of the weevil collected at different times during the season were confined; some in the insectary, some exposed on the ground in the partial shade of the plants, and some were placed in continuous bright sunlight (without shade). Where the squares were kept shaded in the insectary 67.4 per cent produced weevils; where the squares were partly shaded by the plants (natural conditions), 55.1 per cent produced weevils; where the squares were kept in natural sunlight as it occurred during the season only 25.3 per cent produced weevils.

Approximately 2.1 per cent of the squares were parasitized by other insects.

Further artificial control experiments were conducted which are as yet uncompleted at this writing.

During the year the following were published pertaining to boll weevils:

North Carolina Boll Weevil Program for 1924, section on "Direct Methods for Boll Weevil Control," by F. Sherman, N. C. Ext. Folder No. 14 (January, 1924).

Habits and Control of Cotton Boll Weevil in North Carolina, by R. W. Leiby and J. A. Harris, Bull. State Dept. Agriculture, published for Agricultural Experiment Station (March, 1924).

In confirmation of the benefits of the dust-poison method of control, we have secured data from agencies which have coöperated with our Extension Service in demonstrating this standard method of control. We now have yield data from 58 tests, in 19 counties, in three years; in each case cotton being left undusted for comparison. The average of all these tests shows a gain of 246 pounds seed cotton per acre by proper use of the dust-poison method.

The weevil damage averaged light during 1924.

No. 13. Household Insects. This project was undertaken several years ago by an assistant who later resigned, and the work has been inactive since that time. A considerable body of notes is on file, from which at least a brief publication might be written.

No. 14. Plum Curculio on Peaches. Work on this project has been continued during 1924 by Dr. R. W. Leiby and Mr. J. A. Harris with headquarters in the Division's field laboratory at Aberdeen. The life-history of the curculio was again followed through, and upon the strength of the findings of the workers, ten letter bulletins were mailed during the season to commercial peach growers in the sandhills instructing them when to institute control operations which included spraying or dusting and the picking up of dropped fruit.

Investigations on insects are best conducted in field laboratories. Above is view in the Aberdeen Peach Insect and Boll Weevil Laboratory.

The work during 1924 was concentrated largely upon field control of the curculio and the brown rot and scab diseases, on two commercial varieties, the Slappey and Elberta.

Where the Slappey trees were carefully treated for curculio, less than two per cent of the fruit was wormy at harvest. Untreated trees showed 22.2 per cent of the fruit wormy at harvest.

A series of seven plats of Elberta trees were used to ascertain the effect of new dry-mix lime-sulphur combinations to control insects and diseases and to note their effect upon the foliage. The complete results have been issued in letter Bulletin No. 8. Satisfactory results were secured with a 5-7-½-50 dry-mix formula. Where the trees were sprayed twice with this material in the regular four-spray schedule there was no rot or scab and 0.8 per cent of the fruit was wormy at harvest. Where similar trees were left unsprayed 1.04 per cent of the fruit at harvest was rotted, 2.7 per cent was scabby, and 16.3 per cent was wormy.

The second publication on this project was issued as Extension Circular No. 144 of the N. C. Agricultural Extension Service entitled *The Plum Curculio on Peaches and its Control*, by R. W. Leiby and J. A. Harris (March, 1924). This circular gives recommendations based on our findings for 1922 and 1923, and also includes considerable biological data.

No. 15. Fall Canker-worm in Mountain Forests. A number of local outbreaks of this pest in the years 1917 to 1920, caused Mr. F. Sherman to locate at Linville Falls to conduct observations.

As the application of poisons, or of the banding method of control was impractical in the mountain forests affected, the studies centered upon the course of the outbreak and the operation of natural enemies. From these studies we were able to foresee a subsidence of the outbreaks, for birds and predaceous insects seemed to be increasing in the worm-areas, and an egg-parasite was found to be highly efficient. The chief findings were recorded in a paper published in the Journal of Economic Entomology. In 1921 two small lots of the European Ground-beetle *Calosoma sycophanta* were secured from the U. S. Gipsy-moth Laboratory at Melrose Highlands, Mass. These were liberated, but a brief search in summer of 1922 failed to reveal survivors or progeny.

As there has been no recurrence of the outbreak, no new work has been done on this project during the year.

No. 16. Control of Peach Tree Borer. A few necessary observations have been made on the life-history of the borer. Experiments for control have been confined to three-year-old trees. One-half ounce of paradichlorobenzene per tree has given satisfactory control when applied early in October. No injury to the trees has been observed. Directions for use of paradichlorobenzene have been issued as letter Bulletin No. 9 of the Division by R. W. Leiby and J. A. Harris and mailed to commercial peach growers. An extension circular and bulletin summarizing our work on this project will shortly be prepared.

No. 17. Parasites of the Hessian Fly. This project is of a biological and morphological nature, and is carried on by Dr. R. W. Leiby. Two of the parasites of the Hessian Fly have been found to have a peculiar type of development known as polyembryony, whereby more than a single individual is developed from a single egg laid by the mother parasite in the egg of the Hessian Fly while it is on the wheat plant.

The parasites of the Hessian Fly largely hold this wheat pest under control. A knowledge of their behavior and development is therefore of value. One of the parasites has been reported upon under title of *The Twinning and Monombryonic Development of Platygaster Hiemalis, a Parasite of the Hessian Fly*, by R. W. Leiby and C. C. Hill (Bur. Ent. U. S. D. A.) in Journal Agricultural Research, Vol. 25, No. 8, August, 1923. This paper illustrated the most simple type of polyembryony possible, whereby some of the eggs gave rise to twins while others developed single individuals from single eggs.

A second paper on this project entitled *The Polyembryonic Development of Platygaster Vernalis*, by R. W. Leiby and C. C. Hill has recently been issued in Journal Agricultural Research, Vol. 28, No 8, May, 1924. This

paper traces the development of the parasite from the time the egg is laid until the adults mature in the Hessian Fly pupa case. One egg of the parasite gives rise to eight to fifteen adult parasites. Development is initiated in the egg of the Hessian Fly, continued in its stomach, and completed in the body of the larva, while the latter is feeding upon the wheat plant. A parasitized host always dies before maturing into the fly state, and the parasites are therefore classified as beneficial and of economic importance.

No. 18. Mexican Bean Beetle (Epilachna corrupta). Mr. J. C. Crawford is engaged on this project; and the operations which were conducted at Bryson City in 1923, were conducted at the Mountain Branch Station in 1924. Since conditions, particularly the amount of rainfall, are different in these two localities, the general life history in the beetle was again carefully worked out. In general this coincided very well with previous findings at Bryson City. The beetles began to emerge from hibernation during the last week in May and development went on through the three generations as at Bryson City but with the marked difference that the generations overlapped to such an extent that there were not the three marked crests of emergence of adults so characteristic of the year at Bryson City.

During 1923 at Bryson City a single specimen of a parasitic fly was reared from a larva of Mexican Bean Beetle, and as this fly is a common parasite of the Squash Lady-beetle which is closely related to the Mexican Bean Beetle, careful search has been made for further evidence of its activities, but without success. Mr. Crawford has thus secured one bit of proof that a parasite which is native in our State has begun to attack this new invader.

Poison tests were conducted using both dusts and sprays, again giving almost equal degrees of protection. Considering cost of material as a prime factor the best dust appears to be calcium arsenate one part, by weight, hydrated lime nine parts. For spraying: calcium arsenate ¾ pound, hydrated lime 2 pounds, water 50 gallons.

In dusting, guns of both bellows and fan type were used, the former showing distinct advantage both in amount of dust used and ease of operation.

Messrs. T. B. Mitchell and J. A. Harris did scouting work in the autumn to determine the eastward spread of the insect during 1924. It was found that the advance line of infestation is now entirely east of our mountains and extends in a fairly straight line approximately from Catawba River (west of Charlotte) at the South Carolina line to the Virginia line somewhat west of Mount Airy in Surry County.

Pertaining to this project the following bulletin was issued during the year:

The Mexican Bean Beetle in North Carolina—Studies and Tests for Control, by J. C. Crawford, Bulletin of State Department of Agriculture, published for the Agricultural Experiment Station (November, 1924).

WORK ON SUBJECTS NOT LISTED AS PROJECTS

While some of our listed projects have been inactive during the year from force of circumstances, conditions have seemed to call for some attention to

certain subjects upon which no formal project had been outlined. The men who are located at outlying places (field stations or branch stations) have opportunity to conduct studies which are not possible at the Raleigh headquarters.

Codling Moth Control. With a view of taking up this subject as an additional project at the Mountain Branch Station next year, Mr. Crawford made some preliminary observations during the past summer. His findings indicate that (in 1924) the second generation was small and that the greater part of the damage to the apple crop was by the first generation. An examination of a large number of apples for damage by this insect was made during the picking season of the various varieties, these showing only about one apple out of two hundred with live Codling Moth. About four and one-half per cent had marks of side-injury which were so small that the apple nevertheless graded as A-1. In these cases Mr. Crawford believes that the marks were usually by Codling Moth larvæ which succumbed to the spray-treatment.

These observations indicate that the spray schedule recommended from this office and applied by Superintendent S. C. Clapp (formerly of this office) at this branch station, gave a remarkable degree of protection. It is desired to continue observations on this control feature, with enough biological work to enable us to understand the reasons for its results.

Pickle Worm. This insect is severely destructive to cantaloupe and related crops in our mountains as well as in other parts of the State. It was intended to conduct some preliminary studies this year at the Mountain Branch Station, but owing to extreme drought during the blooming season the studies were not prosecuted.

San Jose Scale Control on Peach Trees. After a long period of years during which this insect has been held in satisfactory control by the use of lime-sulphur sprays in our sandhills peach section, the San Jose Scale has recently shown signs of a revival in its destructiveness. This condition has been commented upon by workers in other states, and recently there has been a tendency to resort to oil sprays, for a time at least.

Consequently, Messrs. R. W. Leiby and J. A. Harris, who have been stationed at Aberdeen, conducted some tests late in the winter of 1923-24. The trees used were in an orchard at Hoffman, N. C. Ten plats consisting of approximately 100 trees each were used. Two home-made oil emulsions, two proprietary miscible oils, and three sulphur compounds were tested. Later examinations of scales from the several plats gave the following average of results:

Average of the oil sprays	97.7 per cent of scales dead
Average of the sulphur sprays	88.1 per cent of scales dead
Average of check trees (not treated)	34.7 per cent of scales dead

Recurrent Outbreaks of Insect Pests. In the opening pages of this report I have referred to personally-kept records now extending over many years, from the time entomological work was first established on an independent basis in this State, these records showing the volume of complaint against any pest by months, by years, and by geographical distribution, thrughout

this entire period. Some pests are notably spasmodic in their outbreaks, such as Army-worms, Green Clover Worms, and Fall Canker-worms, on which we have definite projects; and a number of other pests act in the same way (Cotton Red Spider, Cotton Leaf-worm, Hessian Fly, Chinch Bug, and others).

In discussing our projects in this report, I have mentioned several instances in which we have found *natural enemies* to have a strong influence in subduing outbreaks of insects. Assuming that weather conditions are perhaps the most important of all the natural factors of control, we nevertheless have repeatedly observed that predators, insect parasites, and disease seemed to be chiefly instrumental in subduing an epidemic insect outbreak. In such instances, circumstances which prevent the natural enemy from acting in full force permit the pest to work havoc; whereas when the natural enemy works in full force the pest is held in subjection.

In the second paragraph above I refer to the recurrence of epidemic outbreaks; in the next paragraph to the accepted explanations of these occurrences.

These records are history—entomological history. If the old saying that "history repeats itself" were unvariably true, these records might form a reasonable basis for expecting, or for predicting, epidemic outbreaks, but let me say in the same sentence that ability to predict them with certainty is not claimed. But they do form a basis for tentative expectations.

With one possible exception I know of no experiment station which has kept such a record as we have. And in this connection I consider our Insect Survey project to have an important and enlightening bearing. Only two other states (New Jersey and Connecticut) have published lists aimed to portray the complete insect life of their states; workers in New York are now preparing such a list.

It is my conviction that these records and the Insect Survey will become of increasing value the longer they are continued. Already they give an understanding of insect events which we surely would not otherwise possess.

MISCELLANEOUS WORK

This office handles a very considerable amount of correspondence and clerical work, not only in answering letters from farmers, fruit-growers, county agents and other citizens, but also in giving estimates on insect damage, probabilities, usage of insecticides, answering questionnaires of committees regarding various activities, plans for work, writing revisions of projects, reports, articles for the press, papers for presentation at meetings or for publications, etc. These matters occupy the time of Miss Marion, clerk, and take much of the time of the writer, who endeavors to leave the other workers as free as possible to apply their energies to the several projects which they have in hand.

I trust that this report gives a satisfactory showing of findings and accomplishment for the year: though work has not been done on every project, such deficiencies have usually been because of absence of the pest concerned

ACKNOWLEDGMENTS

It is a pleasure to testify to the willingness, industry and competent service of each member of the staff, each of whom has been mentioned in discussing the projects in which he has taken most active part. I feel that the projects represent a helpful program, and that our efforts have been distributed among them with fairness.

Finally, I wish especially to acknowledge the kindly support, encouragement and counsel which you as Director have always given us in our work.

Respectfully submitted,

Franklin Sherman,
Chief in Entomology.

REPORT OF ENTOMOLOGIST

To the Director: I have the honor of transmitting herewith a brief report of the Division of Entomology, College Station, for the calendar year. Practically all the time of the entomologists is devoted to the project number 6, on the Biology of the Leaf Hoppers. In addition some little time is devoted to two other projects; project number 2, on the Corn Root Worm, and project number 8, on the Corn Ear Worm.

We have continued the study of the Classification of the Leaf Hoppers of Eastern North America, and a paper covering the Plant Hoppers of Eastern North America, is ready for publication. The classification of other groups will follow as rapidly as time will permit.

In addition to studying the Classification of Leaf Hoppers of Eastern North America, your entomologist is called upon to make classifications of Leaf Hoppers from various parts of the world. Large collections have been received from Columbia, from Argentine, the Philippines, China, the East Indies, British East Africa, Madagascar, and Cuba. A paper discussing the Frog Hoppers of Cuba is now in press. This paper will be followed by other papers discussing the different groups of various parts of the world, as rapidly as time will permit.

The bibliography of the Leaf Hoppers of the world is being checked for the final time, and will soon be ready for publication.

Studies of certain ecological groups are being continued, and a paper discussing the Beach Pool-Leaf Hopper Complex, was published in Ecology, Vol. v, pp. 171-174.

A study of the Structure of Leaf Hoppers is being continued. A series of papers have been published on the wings, and papers discussing the structure of the head and mouth parts, and the structure of the abdomen, are about completed.

Practically all the time that has been given to the Corn Root Worm during the past year, has been devoted to the attempt to establish the relationship between crop rotation and the damage caused by this insect. For this purpose, we have been able to secure data on the agronomy rotation plats at the Central Farm, and on the branch stations at Wenona, Rocky Mount, Statesville and Swannanoa, and have started a long time rotation experiment at Willard.

In the Corn Ear Worm project, we are securing data over a series of years on the relation of the time of planting and injury by this insect, and on the relation between varieties and injury caused by this insect.

Respectfully submitted,

Z. P. METCALF,
Entomologist.

REPORT OF DIVISION OF PLANT PATHOLOGY

To the Director: The following brief summary of the investigational work of this Division during the past year is made in compliance with your request.

Tobacco Frenching. All attempts which have thus far been made to determine the cause of this disease have been fruitless. It has been found to be impossible to communicate frenching from diseased to healthy plants by applying macerated frenched leaves to the surface of normal tobacco foliage. Diseased buds have been grafted upon healthy stalks with no evidence of transmission of the trouble to the healthy portion. This evidence shows that frenching is not infectious and in this regard confirms the results of previous investigations at other stations.

Soybean Diseases. Work on certain soybean diseases was begun at this station eight years ago and as a result several of the more important maladies of this crop are now well known. The results of these studies have been published from time to time as mentioned in previous annual reports. During the past year, it has been deemed advisable to so modify the scope of this project as to render it possible to make a comprehensive study of soybean diseases in North Carolina. It has been found that there are at least twelve distinct diseases of this crop within the State about half of which appear year after year and are to be regarded as of major importance. The others cause minor damage and are not generally prevalent.

An account of the studies on soybean mildew was published during the year. Further study has been made possible since this disease appeared in epidemic form during a protracted rainy period in June of the past summer. Inoculation work has shown that it is distinct from clover mildew with which some investigators have considered it identical. Specimens of soybean mildew from the Orient have been compared with our collections and have been found to be alike. The disease has been shown to be seed-borne.

Anthracnose of soybeans which in the previous report was believed to be due to Glomerella cingulata has been shown to be distinct. The anthracnose fungus has been compared with the apple bitter rot fungus in cultures and in cross-inoculation studies. It penetrates the pod wall and infected seed are thus a means of propagation of the disease. Its conidial stage is morphologically like Colletotrichum glycineum, first described from Japan. The winter stage has been found on decaying stems which had remained in the field during the winter. This points to the employment of rotation as one of the means of control.

The results of investigation on bacterial pustule mentioned in the report of the previous year have been submitted for publication. This disease, which is characterized by pustular outgrowths on the foliage is generally prevalent in this State and occurs also in Texas, Louisiana, Virginia and Kansas. It is distinct from bacterial blight previously described from this

Station. The causal organism is morphologically and culturally indistinguishable from the well-known blight of garden beans.

Another of the diseases of this crop to which attention has been given is a root rot disease due to Pythium de Baryanum. This organism is a well-known soil inhabitant and attacks a wide variety of plants in the seedling stage. It has not previously been reported, however, on soybeans.

Little that is new has been added during the year to the data on brown spot disease, Septoria glycines. The yearly cycle of disease has been worked out so that a rational basis of control has been established. The identity of the disease has been established by comparison with type specimens from Japan. A complete report of this work is contemplated in the near future.

Work is in progress on a root rot disease with which Sclerotium bataticola is associated.

Strawberry Leafscorch. A technical paper embodying the results of this research has been published. Since the disease was not destructive during the past spring the field experiments on control have yielded little of value. The work is being continued, however, and it is planned to prepare during the coming year a popular bulletin to deal especially with the field trials on control which are based on the knowledge gained from the life history studies.

Control of Seed-borne Infection. Definite and satisfactory progress has been made in the work of devising a dry heat treatment for the control of certain seed-borne diseases. The major part of this work has been with cotton seed and it is now believed that anthracnose can be completely eliminated from any lot of infected cotton seed by the application of dry heat. A special machine has been built in which seed in quantities of from three to four pecks can be treated at a time. Definite temperature limits and time intervals have been determined whereby all anthracnose can be killed with no concomitant injury to germination. The results of this work can be employed by commercial concerns, seed breeding associations, or coöperative groups, but probably cannot be carried out by individual farmers. A detailed report of these studies will be published during the year.

Special studies have been made on the changes in seed resultant on treatment. Most attention has been devoted to the changes in enzyme activity. A separate paper is planned to embody the chemical changes which occur in seed which have been treated by means of dry heat.

Wheat Take-all Control. This project is being conducted in coöperation with the Office of Cereal Disease Investigations, U. S. Department of Agriculture. The burning of the stubble following the application of kerosene was without apparent beneficial effect. Oats and rye when planted on thoroughly infected soil remain free from infection, and are to be regarded as nonsusceptible to take-all. These crops can therefore be grown safely on infested soils. Head selections of several varieties of wheat which matured on badly infested soils have been made and these seed will be used for planting during the coming year. These tests are the most extensive

ones on take-all in the United States although the disease has been collected in isolated localities in about a dozen different states. It is hoped that take-all resistant strains of wheat can be secured by these trials, in which case, the results would be of general application to wheat growing.

Wheat Take-all was first found on the farm of E. C. Smith, at Lincolnton by County Agent J. G. Morrison.

Dewberry Anthracnose. This investigation is being conducted conjointly with the Office of Fruit Disease Investigations, Bureau of Plant Industry, U. S. Department of Agriculture. Anthracnose appeared, during the past season throughout the sandhill section, in epidemic form. In many fields as much as half of the crop was destroyed. Very satisfactory control has been secured by the removal of the canes as soon as possible after the crop has been harvested. This procedure must then be followed by the applications of spray, one in late summer to protect the new canes, another in spring after the vines have been tied up and another as soon as the flowering season is over.

Aside from the work on these projects, an investigation of a blight of cotton, due to Ascochyta gosypii, has been begun. This disease appeared in epidemic form in Arkansas in 1920 but was not known in North Carolina previous to the past summer. It was reported in July in epidemic form as a stem blight in thirty-five counties of the State. Later in the season, it occurred in more or less serious form on leaves and bolls. The causal organism has been isolated from stems, bolls and leaves and shown to be pathogenic.

Collections have been made of a number of diseases which appear to be worthy of mention mainly because they are little known or entirely unknown. One of these is bacteriosis of peaches, Bacterium pruni, which causes serious losses to the growers in the sandhills. The control of this disease should be made the object of a special study. Other diseases which have been noted include a leafspot of crimson clover due to a species of Cercospora; a leaf and stem disease of cowpeas, due to a species of Ascochyta; the cowpea pod disease, with which a species of Phoma is associated; a rose canker and bud blight not previously collected within the State due to Diaporthe umbrina; a leaf blight of roses due to an undescribed species of Polyspora; and a bacterial soft rot of tomato fruits due to Bacillus aroideæ, a disease which has recently been described by the Virginia Agricultural Experiment Station.

The several detailed reports of the investigational work of this Division which have been published or submitted for publication during the past year include the following:

1. *Bacterial Leafspot of Clovers.* Jour. Agr. Research 25: No. 12, 471-490, fig. 3, pl. 6, 1923. (In coöperation with University of Wisconsin and the U. S. Dept. of Agriculture.)

2. *Strawberry Leafscorch.* Jour. Elisha Mitchell Sci. Soc., 39: 141-163, pls. 9-15, 1923.

3. *A New Downy Mildew on Soybeans.* Jour. Elisha Mitchell Sci. Soc., 39: 164-169, pls. 16-17, 1924.

4. *Bacterial Pustule of Soybean.* Jour. Agr. Research (In press.)

5. *The Manner of Infection of Peach Twigs by the Brown Rot Fungus.* Phytopath, 14: 427-429, 1924.

Very respectfully submitted,

F. A. WOLF and
S. G. LEHMAN, collaborating,
Division of Plant Pathology.

REPORT OF DIVISION OF HORTICULTURE

To the Director: I submit herewith the report of the experimental work of the Division of Horticulture for the fiscal year ending June 30, 1924.

GENERAL

The greatest interest in both commercial and home horticulture that has ever existed in the State has resulted from the operation of existing agricultural conditions and conditions in different horticultural industries which include the general economic need for diversification, boll weevil conditions, and a realization of the advantages of the State for horticultural crops. This interest has resulted in increasing demands on the Division of Horticulture for service of an investigational nature.

Considerable attention has been given to a more thorough direction and organization of the work. The organization of investigation so that direct attention to problems of outstanding importance may be developed has been kept in mind. Every attempt is being made to develop a program of work which will contain live projects definitely adapted to fundamental and special problems of the State. The projects are being organized so that problems of first importance will be selected, and so that the expenditure of funds and energy on problems of only local application will be limited. Each project is reviewed each year with a critical attitude to see if it is fulfilling the purpose for which it was intended.

In general, satisfactory progress should be reported in the experimental work with apples, peaches, pecans, sweet potatoes and Irish potatoes. Certain specific projects were discontinued temporarily because of the lack of funds to properly conduct them. Unfavorable weather in spring interfered with some of the fruit investigations.

From the standpoint of station work, chief mention should be made of projects in apple pruning, cultural practices, variety testing and seed development with Irish potatoes; cultural practices, seed selection, storage investigation with sweet potatoes.

Pruning work with apples conducted at the Mountain Station is giving conclusive results in the value of training apple trees to the modified leader and the use of a light system of annual pruning. It has demonstrated further that the majority of our growers who do prune, cut their trees severely with the result that fruit-bearing surface is greatly reduced and the trees are much later in coming into bearing. Five years' results have been secured in this work and it is clearly evident that they are going to be worth thousands of dollars to apple growers.

The project of developing in the western part of the State methods for producing seed Irish potatoes that are superior or equal to Maine seed, has given results that indicate that this is a practical proposition and opens up new possibilities in potato growing in Western Carolina.

Investigations with improved cultural practices in growing sweet potatoes are showing the value of these practices in giving increased yields, and at the same time more uniform potatoes. One of the big problems in the sweet potato industry is to secure strains which will produce a higher percentage of uniform sweet potatoes. Selection work in this connection which has been conducted for the last eight years, is producing striking results. The main problem in connection with sweet potato storage has been very well worked out, but there are many minor problems which need to be solved, and these are receiving our attention at this time.

As a result of the investigational work with pecans, it has been definitely proved that Schley, Stuart, Success and Alley varieties are of greatest value in Eastern Carolina. A number of points in connection with the soil requirements and cultural practices of pecans have been worked out.

Preliminary investigation with winter injury of peaches which has been severe in the sandhills and eastern part of the State in the last few years has brought out many interesting facts and suggestions for future work in solving this problem.

With the development of many new horticultural industries in North Carolina, and with future progress in established industries, there is an increasing number of problems for investigation. To adequately cover the investigational field presented by the increase of horticultural industries, it will be necessary for the Division to receive additional funds and to be provided with additional facilities to adequately conduct this work.

EXPERIMENTAL WORK IN POMOLOGY

C. D. MATTHEWS AND W. A. RADSPINNER

1. Variety Work in Pomology

Notes and observations on the behavior of varieties of fruits in the different sections of the State are made from year to year. These notes and observations show the range of adaptability of the varieties in different sections.

Much time and care is expended each year in writing, revising and checking descriptions of almost all of the important varieties of fruit grown in the State. These descriptions are to be used in future publications and are employed by the Division as an aid in identifying varieties of fruit sent to the office from over the State.

2. Native Fruits of North Carolina

The place of origin, the history, and the description of a number of varieties of North Carolina origin have been secured. When opportunity offered, the descriptions of varieties secured previous to this season were verified. Paintings and photographs have been made of the most important varieties.

3. Investigational Work with Peaches

(Mountain Station, Coastal Plain Station, Piedmont Station, Upper Coastal Plain Station.)

(*a*) *"Dehorning" Peach Trees.* No active work done on this project during the year.

(*b*) *Peach Breeding.* The object of this project is to produce improved commercial varieties that are more suited to North Carolina conditions than are the present varieties. It is the purpose to produce varieties hardier in bud than the present commercial sorts.

To provide working material for this project a variety orchard containing over sixty different varieties of peaches was planted at the Truck Station during 1917. These trees have made a very satisfactory growth since being planted. Some very valuable preliminary work was done in regard to collecting data concerning the characteristics of the different varieties.

(*c*) *Hardiness of Peach Varieties in Western North Carolina.* Twenty varieties of peaches, comprising those adapted both to extreme northern and southern conditions, were planted at the Mountain Station in the spring of 1919 to furnish material for work on determining the relative hardiness of different peach varieties in Western North Carolina. These trees have made a very satisfactory growth since being planted.

(*d*) *Phenological Studies with Peaches.* The practice of collecting phenological notes on the peach varieties in the varietal peach orchard at the Coastal Plain Station was started during the spring of 1920. These notes will be of value in handling the breeding project.

4. Investigational Work with Pecans

(Coastal Plain Station, Upper Coastal Plain Station, and Piedmont Station.)

(*a*) *Variety Testing.* Thirty-two of the most important southern varieties are included in this test which has been conducted for fifteen years. Results secured from this work show that certain varieties have marked adaptability to North Carolina conditions, while others are proving to be undesirable. At this time, recommendations regarding pecan varieties for planting in this State can be made. According to the results secured, the Schley, Stuart and Alley varieties are the most desirable for Eastern North Carolina.

(*b*) *Individual Tree Performance.* The securing of performance records of the individual pecan trees in the experimental orchards at the several stations is being continued from year to year. Such a record affords a more detailed study of the behavior of the different varieties. As a result of the individual tree performance records, it has been noted that trees of the same variety under identical conditions are uniformly heavy yielders, while others are very poor producers, that some produce uniformly large nuts and other uniformly small nuts. As these individual performance records suggest the possibility of improving and standardizing individual yields by bud selection, work has been started along this line.

(*c*) *Cultural Practices.* The value of correct cultural practices, such as tillage and the use of cover crops, is clearly shown in the increased size and number of nuts produced when compared to trees and their products grown in sod. To determine the most desirable system of tillage and cover cropping to be employed in pecan orchards, work of this nature is being conducted at the branch stations.

Harvesting the pecans from the experimental grove at Upper Coastal Plain Station in Edgecombe County.

(*d*) *Pecan Breeding.* The seedlings, as a result of pecan breeding work, that were set in 1915 at the Coastal Plain Station, are making a satisfactory growth. Some of these seedlings are of bearing size and should produce some nuts during the coming year.

(*e*) *Top-working Pecan Trees.* The investigations dealing with the methods of budding and grafting employed in top-working pecan trees was continued this year. It has been found that a combination of both grafting and budding should be used to secure the most satisfactory results. As a result of years of investigation, it is the opinion of this Division that top-working should be confined, as a general rule, to trees not over eight to ten years old, to be entirely successful.

(*f*) *Cracking Tests with Pecan Varieties.* The cracking test of the different varieties is made each year. The cracking test is a necessary adjunct to the performance record of a given variety in determining its value in a certain section. Very often a variety is highly satisfactory from a productive standpoint, but the cracking test shows it to be nearly worthless from a utility viewpoint. The cracking test shows the number of nuts per pound and determines the per cent of unbroken halves the variety will crack out, the per cent of shrunken kernels, the per cent of physiological spot, the per cent of faulty nuts, and shape and size of the kernels, the texture, quality and flavor of meat, the per cent of meat and the thickness of shell. As a result of these cracking tests conducted each year, certain varieties that were satisfactory from a productive standpoint proved to be totally unsuited to North Carolina conditions.

5. Investigational Work with Strawberries

(Coastal Plain Station)

C. D. Matthews and Robert Schmidt

(*a*) *Variety Testing.* This project was discontinued temporarily because of lack of funds. The variety-testing project with strawberries was initiated several years ago with the purpose of determining whether or not there were any other varieties more desirable as commercial market varieties than Klondike and Missionary, the two leading commercial varieties. For this State the most profitable berry combines the characteristics of productiveness, earliness, and shipping quality. None of the varieties so far tested have shown themselves superior to Klondyke and Missionary as commercial varieties. Several of the varieties have shown themselves valuable for home use.

6. Investigation with Apples

(*a*) *Pruning* (Mountain Station). The pruning project was begun during 1919 with the intention of securing information on the desirable height to head apple trees, to determine the comparative value of the open head and the modified leader system of training, and to secure information on the amount of annual pruning most desirable. To supply material for this work, an orchard containing approximately 128 trees was planted at the Mountain Station in the spring of 1919. The trees have made a very satis-

factory growth and the first five years work has been completed as planned. The results so far secured indicate that growers have been pruning too severely, thereby causing a reduction in fruit production. Light pruning is the most satisfactory.

(*b*) *Apple Thinning* (Mountain and Piedmont Stations). Experiments to determine the effect of thinning fruits and leaves from the fruit spurs of the apple were initiated. Work on this project has not been conducted a sufficient length of time to supply information on the subject.

(*c*) *Summer Apples* (Coastal Plain Station). The summer apple orchard at the Coastal Plain Station did not produce a crop this season because of frost injury.

EXPERIMENTAL WORK IN VEGETABLE CULTURE

C. D. MATTHEWS AND ROBERT SCHMIDT

1. Investigational Work with Sweet Potatoes

(Coastal Plain Station and Upper Coastal Plain Station)

(*a*) *Variety Testing.* It is the purpose of this work to determine the most desirable varieties of sweet potatoes for Eastern North Carolina from the standpoint of productivity, market value, keeping quality and quality. There were twenty-nine varieties under observation this year. The results were in the main confirmatory of the work of previous seasons. Nancy Hall and Porto Rico have proved their desirability, while others have shown themselves to be undesirable.

(*b*) *Storage.* In connection with the variety work, storage tests are being made from year to year in the storage houses to determine the behavior of the different varieties in storage. Certain varieties have proven themselves to be better keepers than others.

Investigations to determine the relation of time of digging to keeping quality, the relation of proper harvesting to keeping quality, the proper method of curing, and the correct management of the house, has been continued this season.

As a result of this work, the Division can make recommendations regarding varieties for storage and the most desirable methods to employ in the management of the storage house.

(*c*) *Cultural Practices.* During the year, work was conducted to secure information on the following different cultural practices:

(1) The comparative value of slips vs. vine cuttings as regards productivity.
(2) The effect of ridging on productivity and type of potatoes.
(3) The effect of vine cuttings on yield.

(*d*) *Seed Selection.* The following lines of work dealing with the seed selection of sweet potatoes were conducted during the year:

(1) To determine the relative value of seed stock from high-yielding and low-yielding hills as regards productivity and uniformity of potatoes.

(2) To determine the relative value of vine cuttings as compared with slips for maintaining yield and type, commencing from the same hill.

(3) To determine the comparative value of large and small potatoes for seed.

(4) To determine the comparative value of seed from late vine cuttings and seed from main crop draws as regards productivity, type and keeping quality.

Satisfactory progress has been made on this project for this year.

Pulling Sweet Potato sprouts at the Upper Coastal Plain Station. Well-grown and disease-free plants are half the battle.

2. Investigational Work with Irish Potatoes

(*a*) *Variety Testing* (Mountain Station). The testing of varieties of Irish potatoes to determine the most desirable varieties for Western North Carolina conditions was discontinued temporarily this year. The test has been in progress for a sufficient length of time to afford this Division with the necessary information to make reliable recommendations regarding the choice of varieties for the western part of the State.

(*b*) *Variety Testing* (Coastal Plain Station). Satisfactory progress was made on the studies to determine the most desirable early varieties for Eastern North Carolina and the best varieties for the second crop.

(*c*) *Cultural Practices* (Coastal Plain Station). Work was conducted to determine the effects of different cultural practices on the yield of potatoes. Those practices receiving consideration were:

(1) Width of rows.
(2) Distance apart in the rows.
(3) Freshly cut or stored cut seed.
(4) Effect of sprouting on yield.
(5) Cut versus uncut seed.

(*d*) *Testing the Value of Different Sources of Seed.* Experiments were conducted to determine the comparative value of Maine grown seed, second crop seed produced in the coastal plain, and Western North Carolina seed in different stages of maturity as the most desirable seed for the early crop of Irish potatoes in Eastern North Carolina.

Results so far secured indicate that this is a practical proposition and opens up new possibilities in potato growing in Western North Carolina.

(*e*) *Investigation of Methods for Producing Seed Potatoes in Western North Carolina for Use in Eastern North Carolina.* Two methods of attack are being used in this investigation. One consists in growing the seed at different elevations, while the other consists in planting the potatoes at different times in the spring and summer. In both cases it is intended to secure seed at different stages of maturity. At present results indicate that elevations over 2,500 feet will grow desirable seed for Eastern Carolina.

3. Investigational Work with Cabbage
(Mountain Station)

(*a*) *Variety Testing.* The testing of varieties of cabbage to determine the most desirable varieties for Western North Carolina was continued this year. The testing has been in progress for a sufficient length of time to afford this Division with the necessary information to make reliable recommendations regarding the choice of varieties for the western part of the State.

Respectfully submitted,

C. D. MATTHEWS,
Chief, Division of Horticulture.

REPORT ON DRAINAGE

To the Director: I hereby submit the annual report on drainage conducted under a coöperative agreement between the North Carolina Department of Agriculture and the United States Department of Agriculture. This report covers the crop year November 30, 1923 to November 30, 1924.

Research on soil erosion and drainage problems constituted the major activities of the division during this period, in accordance with the policy inaugurated July 1, 1923. An installation for the measurement of soil erosion on plots of the same length under different crops and of varying lengths under the same crop was installed on the Experiment Station Farm at Raleigh. Construction was completed during the latter part of May, 1924, and records of rainfall, runoff and erosion have been kept since June first. Information obtained will be of value in determining the optimum spacing of terraces, the effect of various crops on erosion and on rates of runoff. The seriousness of the erosion problem to the Southern farmer is evidenced by records already obtained, which show that during one thirty-day period last summer, erosion from one of the test plots took place at the rate of twenty-five tons per acre.

Studies of the height of groundwater level in a muck soil in Beaufort County and on a typical coastal plain soil in Pender County have been continued. Similar studies formerly carried on at the Black Land Station of the Department, in Washington County, have been discontinued. Considerable time has been devoted to the compilation of the data obtained from these experiments although the material has not yet been put into the form of a report. These data will give a comparison of groundwater conditions in soils of different types, in soils drained by tile lines spaced at varying depths, and between the effect of open ditches and tile drains.

About 400 feet of experimental concrete drain was installed on a farm in Wilson County for the purpose of studying the action of concrete tile in the acid soils of the coastal plain. Treated and untreated tile as well as tile manufactured under different conditions, methods and materials were used. The location is one where difficulty had previously been experienced through the disintegration of concrete tile. The tile is to be examined and specimens tested at intervals to determine its condition.

EXTENSION

While the extension activities of the Division were incidental to the research work during this period, a certain amount of assistance was rendered in selected cases in the matter of tile drainage and terracing, and in giving aid to drainage districts. The larger share of the tile drainage and terracing work was on the lands of State, public, or semi-public institutions, and was carried on in the same way as described in previous reports. Terracing assistance was rendered almost exclusively in Wake County.

Six examinations of a preliminary or reconnaissance nature were made of drainage districts or coöperative drainage enterprises, covering an area of 216,500 acres. These projects were located in both the Piedmont and Coastal Plain sections of the State and included land in eleven counties.

Twelve farms in nine counties were visited for the purpose of rendering assistance in farm drainage. Forty-five hundred feet of tile ranging from four to eighteen inches in diameter were installed and 20,500 feet of open ditches constructed on an engineering basis under the supervision of the Division. Assistance and advice in terrace location and construction was given on eight farms in three counties. Twenty-two thousand feet of terraces were laid off. In addition, all requests for information on these subjects received by the Department were answered in the correspondence of the Division and news articles and the results of investigational work given to the press from time to time.

Respectfully submitted,

F. O. BARTEL,
Drainage Engineer.